Agriculture

The Journal of the Ministry of Agriculture

VOL. LVI No. 8

PUBLISHED 6d MONTHLY

LONDON: HIS MAJESTY'S STATIONERY OFFICE

Please mention the JOURNAL *when corresponding with Advertisers*

AGRICULTURE

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Editorial Offices: St. Andrew's Place, Regent's Park, N.W.1 (*Phone: WELbeck* 7711)

VOL. LVI No. 8 NOVEMBER 1949

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Cover Photograph

MIDDLEHAM, YORKSHIRE

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LEYS GOOD AND BAD

WILLIAM DAVIES, D.Sc.

Director, Grassland Research Institute, Stratford-on-Avon

THE farmers of Britain have achieved much since 1940. Before the war England and Wales had some 16 million acres of permanent grass, of which the bulk was of poor quality and much completely unproductive. During the intervening years the area in permanent grass has been reduced to about 10 million acres, tillage crops have gone up in proportion, and there has been a substantial increase in the area in under leys. This movement was started in the spring of 1939, and great strides were made during the crisis years of the war. But since 1945 the pace of development has abated; in fact the acreage under permanent grass in 1945 was as low as it is today. In the realm of rough grazings, of which there are 5½ million acres in England and Wales, we have done comparatively little, although there have been important additions to our knowledge relative to developing our marginal and hill lands. As a country we may or may not be at the optimum of tillage acreage, but we are certainly not at optimum in relation to the acreage of permanent grass on the one hand and good leys on the other.

It has been said in some quarters that the agriculture of this country is still no more than at "half-cock". This may or may not be true generally, but we are certainly at less than "half-cock" (considerably less in fact) in relation to our grassland production. The land still in permanent grass is not "pulling its weight" in the national effort towards increased food production. The permanent grass still remaining is, by and large, of poor quality, and far too much of it is just lying idle. Even at its best, permanent grass offers no real flexibility when compared with the potentialities that are offered by a well-farmed and productive ley.

It is true that many farmers of a pioneering type of mind have made themselves high-class ley farmers. They are using the ley in all sorts of ways which were largely undreamed of ten years ago, but the proportion of good leys in relation to the whole, particularly long-duration leys designed for three years and upwards, is appallingly small. It is doubtful if many of those who have had only limited experience of dealing with leys realize how poor, in fact, their leys are. Many of the leys one sees up and down the country are poorer and less productive than the permanent grass which they replaced, bad as that often was.

Experience goes to show that one of the many reasons why we still have so much permanent grass in the country is that the technique of establishing and maintaining high-class leys has not yet become common property among the farming community of the country. Those farmers

who have, in fact, learned the technique and the tricks associated with the maintenance of high-class leys have seen the good effects of having such leys established on their farms, and, once that has come about, permanent grass is quickly reduced.

Seeds Mixtures I believe that the general standard of the long-duration ley in Britain has gone down since 1945. A large proportion of the leys now being made up and down the country are being sown with fairly poor seeds mixtures. Not nearly enough emphasis is placed on manuring for high production, and the technique of establishing the ley is often bad. Even after establishment of the ley, there is much that can be criticized in the subsequent management of the sward. With regard to the technique of establishment, leys are far too often sown under corn, which is quite definitely a smothering crop in so far as young seeds are concerned. Far too often, also, too much Italian ryegrass is included as part of the seeds mixture. Italian ryegrass itself is a smothering species, and after it dies out it leaves bare patches in the pasture. Italian ryegrass is a valuable ingredient of the shortest duration leys, particularly as a grazing plant in the one-year pasture ley, but it is dangerous to use it as an ingredient of long-duration leys, except on the poorer types of soil and on hill land.

Too often seeds mixtures which otherwise may be balanced are being based on commercial strains of the several grasses and clovers, and far more emphasis needs still to be placed on those strains which are not only long-lived but are productive throughout their whole life. This is particularly true in the case of Irish and Ayrshire ryegrass, both of which are short-lived and unproductive, except at the very highest levels of soil fertility. In the case of cocksfoot, we are still using far too much of the imported stemmy types, and similarly we use American, Canadian and Scotch timothy, all of which are stemmy, short-lived and relatively unproductive. So much for the seeds mixtures.

Soil Fertility Now to the question of soil fertility, particularly in terms of lime and phosphates. Taking our country by and large our soils are desperately short of lime and phosphates. In many areas potash is equally important, and experience has shown that high-class leys are more responsive than any other crop to the knowledgeable use of nitrogen. At the present moment the value of building up the lime and phosphate content of soils under ley is not by any means fully appreciated. The clovers are an essential basis of the high-class ley and, without adequate phosphates and lime, clovers will not thrive ; neither will they thrive without potash where that is a limiting factor in the soil. There may be other plant foods such as the so-called trace elements which are needed, but we know little about these as yet and they need not, at the moment, bother the ley farmer *unduly*. We may, however, have to face up to this question in the future after more experimental evidence has been obtained.

Having established the ley and taken precautions to feed it properly, there should be no need for the rapid deterioration which does take place over so much of the country at the present time. In the maintenance of the ley, however, reasonably sound management should be applied. If hay is taken from the ley every year and little or no grazing afforded, then that ley will soon deteriorate and become unproductive. In general practice, therefore, it is preferable to alternate the management of a particular ley instead of having the same management year after year. The modern concept of good management should be not whether the pasture

looks well at any particular time, but whether or not it is producing at high level throughout its whole life. It should be capable of starting growth in the early spring, producing feed right through the driest of summers and capable also of producing into the late autumn and early winter. A good ley can be manipulated to do any of these things, but it may not be able to do them all in the one year; nor will it do them in every year if the same treatment is carried out on a particular field year after year. Therefore, alternation of management and treatment is sound practice in the maintenance of high-quality leys. The crux of the value of the ley is whether or not it is *producing at high level and doing that consistently.*

Good Leys pay a Dividend To sum up, bad leys are altogether too common throughout the country and, if we are to get the best out of our land, the country must look to the betterment of its leys as well as looking to its permanent grass. Sowing leys under corn is bound to jeopardize them from the start and to make their maintenance that much the more difficult. Using the wrong seeds mixtures is equally unsound. The advisory officers of the country can put you right on that score.

So, also, with the question of soil fertility—usually a matter of lime and phosphates, with the proper and knowledgeable use of potash. Given proper establishment of the sward and adequate maintenance of soil fertility, then the well-being of the ley depends largely on good management. Look to your leys, for it is the ley which will produce milk and meat, and once you know how to deal with the ley at its best you will soon want to plough up your permanent grass. On the better soils you will want to crop and then to put the land down to good leys. On the marginal lands and poorer types of soil you may need only the *shortest* of arable rotations and the *longest* of grass rotations consistent with keeping the new leys at high production. *Bad* leys are a menace to British agriculture—*good* leys pay a handsome dividend to both farmer and nation.

A FARMER'S GUIDE TO THE SALE OF CORN

The 1949 edition of this handbook provides an easy reference to the provisions of current Orders relating to the production, storage, use and disposal of home-grown cereals, pulses and linseed. The handbook is therefore likely to be useful to farmers and merchants alike.

Copies may be obtained, free of charge, from the Ministry of Agriculture, Leaflet Room, 1 St. Andrew's Place, Regent's Park, N.W.1.

HERBAGE SEED PRODUCTION

The following three papers were read at a Conference held at Stoke Rochford, near Grantham, on July 15, 1949

HERBAGE STRAINS AND FOOD PRODUCTION

T. W. Evans, B.Sc., Ph.D.

EVERY plant of a given family has certain features in common, but plants of the same family differ widely in growth form, root growth, earliness, and time of seed setting: when they vary in this way we call them strains. The idea of strain in herbage plants, and the importance it has assumed, received great emphasis from Sir George Stapledon. It is now thirty years since he founded the Welsh Plant Breeding Station: indeed, Professor T. J. Jenkin, the present Director, started preliminary breeding work even earlier than this at Bangor.

There is no need to stress the difference between the state of our industry then and its place in our economy now. Today we are urged on all sides to grow more food, especially wheat, and increase the output of livestock while feedingstuffs are in short supply and costing more and more. If this state of affairs continues—and there seems little likelihood of it doing anything else—herbage plants are destined to play an important role in our agricultural economy.

But why, you may ask, should plants bred thirty years ago be valuable today in implementing a policy so vastly different from that which prevailed over a quarter of a century ago? The answer can be given quite shortly, in one word; and that word is "persistency". This term describes the ability of a grass or clover to live and thrive year after year when grazed continuously. This power to persist has been bred into these strains; they all possess the quality to a very marked degree. It is a quality that can be used to great advantage but is not yet exploited fully in the drive for greater production.

Seed growers will be familiar with the different strains of cocksfoot, perennial ryegrass, timothy, and meadow fescue, and it is unnecessary to enumerate them here or discuss the reasons why they were given numbers rather than names. The important point is that strains differ greatly in potential usefulness despite their apparent similarity. To say that S.24 perennial ryegrass is better or worse than S.23 perennial ryegrass is to miss the whole point in assessing their value. How then can these strains be used in our drive for greater food production? They should be used to establish vigorous leys on a wide range of soils; and managed to produce the optimum amount of grass while restoring maximum fertility.

The Ley This will not be achieved unless we agree at the outset on what precisely we mean by the term "ley". A ley is turf made for a fixed time and a definite purpose. Time and purpose—these are the twin pillars on which all management rests. How long and to what end will the turf be used? To advise treatment without this information ignores the basic principles of grassland husbandry. There is a tendency to regard management solely as a means of increasing present output. This cannot be right, for the yield in any year depends on how the turf was managed the previous year. Management should not be designed solely to increase immediate output. Management has another equally important function. Every ley serves two needs: producing grass is one of them; the other and, in the last resort, the more important, is restoring fertility. Management must reconcile these needs and be so designed that each ley produces the optimum amount of grass while restoring maximum fertility. By carefully

balancing these needs it is possible to grow cash crops in an ordered sequence when the ley is ploughed ; and the yield of each crop will be high in proportion as the needs of the soil have been satisfied during the life of the ley.

Leys may be varied, ranging from dual-purpose, with several grasses and clovers, to special-purpose, containing one strain of a particular grass and one strain of a particular clover. They can be grown for a short run of years or a long run of years, and may be designed to give abundant keep at certain times of the year or more steady growth through the season. Since leys serve many and different purposes the management fitting to each will be specific.

Dual-purpose leys of the Cockle Park type are still in common use. When Gilchrist designed his famous mixture he was catering for a fixed management, and a management peculiar to the North of England where the winters are long and fodder plays an important part in stock husbandry. The Cockle Park mixture, for sowing under corn, was designed to give hay in the first harvest year. When so managed, late-flowering red clover develops fully and cocksfoot competes successfully with perennial ryegrass. Cockle Park swards, if well established under corn, are best cut for hay in the first harvest year, and can be cut for hay or silage again in the second year. This allows the cocksfoot and red clover to grow away and develop deep roots which play an important role in building fertility by adding to the store of fibre in the soil. In its third and last year the ley should be grazed hard to impregnate the soil with stock nitrogen and secure the rapid spread of white clover before the turf is ploughed.

This management, sensible in a general way, will not suit all farms in all years. The ley, above all things, must be flexible ; and on occasion it might well happen that a field in ley will be mown each year. No harm results from this on good land, but on medium to poor soil the ley should be grazed for the whole of one season, preferably the last.

Cockle Park mixtures have served us well in the past and under extensive systems of farming they may still find an honoured place in the rotation. Their use is, however, unlikely to extend. The advent of leafy strains makes it more difficult on fertile land to establish mixtures of cocksfoot, ryegrass and timothy, even when these are sown under corn. Further, milk production is gaining ground on arable farms ; this, with rising labour costs, sets a limit to the value of Cockle Park leys : despite their dual-purpose nature, they are not flexible enough to meet the ever-mounting needs of the nation and the consequent drain on soil fertility.

Today output is all-important ; we must learn how to exploit each strain of grass and clover to full capacity, both as sources of animal food and builders of fertility. This cannot be done when plants of widely different growth-form are sown together and allowed to develop as best they may under one fixed system of management. Herbage plants develop fully and restore maximum fertility only when competition from other plants is reduced to a minimum.

To this end we must think in terms of special leys and work out how these can best be fitted into various rotations over the whole ploughable area of the farm. In its simplest form this means using hay leys and grazing leys instead of dual-purpose leys. The hay leys can be sown in corn, and the grazing leys direct. Resolving dual-purpose leys in this way gives greater flexibility, both in the time of sowing and in the type of ley to sow. Two or more fields or part fields in the break can be sown with different mixtures, and each ley given its appropriate management to provide hay, silage and grazing at different times, while building fertility according to the needs of

individual fields. In this way flexibility is provided without changing the crop sequence, which used to be (and should remain) inviolate. Flexibility in modern farming there must be, but this should come from different rotations and not from the crop sequence of any particular rotation. Special-purpose leys allow this and, fitted into rotational systems of farming, are a sure means of increasing output while building fertility.

Ley Rotations In days gone by much of our light land was farmed on a rigid four-course system: roots—barley—seeds—wheat. This rotation is now almost a thing of the past, and in departing from it there is a danger that some of our land may be farmed in a manner not conducive to restoring maximum fertility. In passing from rigid to flexible systems, there is a tendency everywhere to practise "free rotations". By free rotations we mean systems of cropping where fields are sown to leys not in accordance with a well-conceived plan, but when they have been overcropped and are overdue for a rest in grass. Such fields when down to grass will often be exploited for grass production and ploughed again if expedient to do so in the interests of further cash cropping or when the ley has ceased to be productive. Such free rotations bode ill for British farming and may not sustain us in the years that lie ahead.

The introduction of the ley into any farming system must be well conceived in time and purpose. At the time of sowing the farmer should know how long he intends the field to remain in grass, and in designing the management for each year of its life he should have clearly in mind the dual function of the ley: namely, the production of grass and the restoration of fertility. Although a restorative crop, the ley does not bestow its recuperative powers automatically. Balancing the use to which a field is put in the interests of present production and supplying the needs of the soil for future production requires careful judgment and skilful planning. It is the hall-mark of real ley farming.

Some farmers on light land have ceased growing roots for sheep and now practise a six-course shift as follows: ley—ley—ley—wheat—barley—barley (undersown). This system is spreading with mechanized corn growing: the leys, dual-purpose in type, are often used for sheep and beef stores. By sowing special leys, this rotation could be modified as follows: grazing ley (sown direct)—grazing ley—wheat—barley (undersown)—hay—barley. Such a system grows more grass and returns more fertility, while avoiding the danger of three successive corn crops. Where root crops are an important part of the farm income the directly sown grazing ley can be used to very good purpose. A sensible rotation would be: grazing ley (sown direct)—grazing ley—potatoes and beet—barley (undersown)—hay—wheat. This again is a six-course shift.

Once the conception of resolving the dual-purpose ley into its component parts is fully appreciated and properly understood, the possibilities for new and novel rotations are almost infinite. Underlying them all is the idea of sowing the grazing ley direct; a technique developed during the war, still in its infancy and bidding fair to become one of the most fruitful developments in modern farming. The keep from direct seeding is known as "maiden" grass—a product that stimulates milk yields beyond what is normally associated with ordinary spring grass. Further, maiden grass from a March sowing is often a safeguard against July-August drought—an asset of inestimable value on every stock farm.

Stocking Leys How should leys be managed? On some farms the grazing is lenient, on others intense, but nearly always it is continuous. The greatest single factor which controls the output from grazing leys is the method of stocking the fields. It is this continuous grazing, whether heavy or light, which reduces the output of leys. Grazing must be controlled for leys to be highly productive; only in this way can optimum output be sustained and maximum fertility restored. In designing management there should be definite rest periods; these must be provided for and the herbage available at any given time eaten off as quickly as possible. Increased output will be related directly to the length of the different rest periods (the longer and more varied the better) and the length of the grazing (the shorter and more varied the better). In other words, greater output and enhanced fertility will be secured only by on-and-off grazing, with short "on" and long "off" periods, the actual dates of resting and grazing being varied as much as possible from one year to the next.

Towards the end of the season, plans should be made for early keep the next year. This can be done by resting fields in the autumn, but never rest the same field at the same time in two succeeding years. When preparing for early bite ring the rest changes as much as possible from field to field. Early silage cuts can be obtained in the same way, but these again should not be taken from the same field year after year. Producing grass at different times of the year is all a matter of resting and manuring at carefully selected periods.

One of the greatest attributes of these new strains is their ability to form numerous side-shoots or tillers from buds at or near ground level. Tiller formation is very important because most grasses die quickly if grazed continuously and keenly without steps being taken to stimulate the buds into active growth. The capacity of a plant to produce tillers is determined by its internal mechanism, but the number of tillers actually formed is influenced greatly by management. Harrowing, cutting and grazing may all be important in stimulating the grass buds to active growth, but the continuous development of tillers after stimulation of the buds is dependent on a regular supply of available plant nutrients, especially nitrogen and phosphate. The new strains, being inherently such prolific tiller-producers, cannot develop their full potential unless manured on a generous scale; and assuming adequate supplies of lime, phosphate and potash, nitrogen exerts the master influence on grass growth. Here I am conscious of entering what has become a rather controversial field. The controversy, however, is more apparent than real. The point to bear in mind when top dressing is to apply nitrogen at different times to the various fields, and at different times to the same field in succeeding years. The increased growth must be consumed quickly; this again points to stocking heavily for short periods with long rest intervals. Temporary fencing will be needed and the electric fence can be used for this purpose. If the grass cannot be consumed quickly it should be cut and conserved in the leafy stage. This too calls for discrimination. Poor fields should not be top dressed and cut for silage; they should always be grazed. If growth is more than can be controlled by the stock, silage cuts must be taken from the fertile fields.

Ploughing Leys One last word. Plough the ley in full vigour—nay, more; dung it heavily and then plough down. This advice is easy to give but hard to take. We have not yet reached the stage of ploughing leys in full active growth. To do so, nevertheless, is implicit in all I have been trying to say; leys must be ploughed at the appointed time, and their management, of set purpose, should be designed to ensure that the

sod, when turned in, is full of white clover and actively growing grass roots. Unless this is done the ley, be it never so productive, will not have served the needs of the soil. I repeat: plough at full vigour; the land will then be farmed for optimum use at maximum need, and this is real ley farming.

The difficulties of ley farming are many: fencing, watering, lay-out, and, not least, changing price emphasis. All these make sound rotations difficult to plan and costly to practise. The needs of the land and the needs of the nation are rarely, if ever, the same at any given time, but they must surely be closer now than ever before. Ley farming, properly understood, is high farming. This is the overall need today, but it must be practised on a fertility-building basis or the land and the nation will ultimately suffer.

A SUCCESSION OF CROPS FOR DRYING

R. E. Slade, D.Sc.

My aim is to produce: (a) dried lucerne meal of 18-22 per cent crude protein, either made into cubes for feeding with cereals or sold as meal to be made up with cereals into dairy rations; (b) dried grass, including barley and rye, with 15-18 per cent crude protein baled and fed at 23 lb. per head for maintenance and the first three gallons of milk; and (c) selected lucerne meal with 15-18 per cent fibre, for incorporation in poultry mashes and pig food.

My first crop, winter rye, was ready for cutting this year about April 20, but it ripens quickly from the leafy high protein stage to the flowering stage in which the protein content is quite low. But it is worth while growing winter rye so that cutting may start at the end of April before the lucerne is ready.

Early in May I start cutting lucerne—and I grow pure lucerne, not mixtures. After four years I plough up the lucerne ley and use the land for crops other than lucerne in the next four years. I grow lucerne without any mixture of grasses because I find that if I grow either cocksfoot or perennial ryegrass with the lucerne it is impossible to get high protein at each of the three cuts, for only by chance are the two species ready to cut at the same time. There is also another reason why I do not grow mixtures. Lucerne does not need an application of a nitrogen fertilizer but grasses must have heavy dressings of nitrogen each year. Although lucerne fixes its own nitrogen, it does not supply enough nitrogen to the crop which is growing with it—at any rate not early in the season.

The lucerne which I have grown for the last nine years has been Canadian Grimm, but I am not able to obtain Canadian seed now, so I am trying Provence and Hungarian varieties this year.

I sow some early-flowering Danish cocksfoot and S.100 white clover for three-year leys on land that has a high water table. This crop receives a good dressing of a complete fertilizer in the spring and at least 8 cwt. of nitrogen fertilizer during the summer, the first dressing being given as soon as the grass begins to grow. From these fields I can get 3 tons of dry matter per acre each year.

We do not know yet what are the best strains of cocksfoot or ryegrass to grow under these conditions of intensive fertilizer dressing. It would be interesting to see trials made of different strains. I consider that cocksfoot is a much more useful grass to the drier than perennial ryegrass, for the latter throws up flowering shoots so quickly; and there is no difficulty in managing cocksfoot if it is being mown three times a year. It does not tend to form tufts as it does in pastures which are not mown regularly.

This year I have put down a straight cocksfoot ley for three years without any clover. I am relying upon the residual nitrogen from the lucerne crop to make an important contribution towards the nitrogen required by the crop during the next three years. I hope I shall find that I can grow a heavy crop without high applications of nitrogen.

The following Table shows the sequence of crops which I have cut this year. Starting with winter rye on April 17 and then starting to cut my first crop of lucerne on May 2, the first fields are cut when the lucerne is 12-18 inches high and long before it has come into flower.

Acres	Date	Crop	Crude Protein *per cent*	Fibre *per cent*	Weight *tons*	*cwt.*	Weight per acre *cwt.*
7	Apr. 17	Winter rye	15-18	—	7	7	21
7	May 2	(1st cut) Lucerne (1st cut)	21	14	6	8	18½
16	May 5	do.	23	15	9	2	11¼
17	May 10	do.	22	15	16	14	19¼
15	May 18	do.	21	18	23	17	31
7	June 1	Winter rye (2nd cut)	12	—	8	3	23
10	June 8	Lucerne and ryegrass	15	25	19	0	38
3	June 16	Barley	10	—	5	14	38
3.5	June 20	New cocksfoot (1st cut)	21	—	3	13	20
6	June 21	Spring rye	18	—	14	2	47
7	June 29	Lucerne (2nd cut)	20	23	9	5	26
16	July 4	do.	19	23	19	13	24
17	July 11	do.	19	25	24	0	28

It will be noticed that the crop on the first lucerne field cut gave 18½ cwt. per acre. This field is early because it is good land on a hill and therefore not so subject to frosts as the other fields. The first crop of lucerne kept the drier employed until June 7, when a second cut of winter rye was taken off 7 acres, and then a field of lucerne and ryegrass was cut. In this field the ryegrass had come into flower, so that the crude protein content of the crop was only 15 per cent, but the bulk per acre was high—38 cwt. After this some barley was cut in the early-flowering stage and gave only 10 per cent crude protein. This barley should have been cut at an earlier stage. A crop of new cocksfoot undersown with S.100 was then cut and yielded 20 cwt. per acre with 21 per cent crude protein.

On June 21 some spring-sown rye was cut, and this yielded 47 cwt. per acre with 18 per cent crude protein. This seems to be the best crop which I have found for filling in the gaps between the first and second cuts of lucerne. On June 29 the second cut of lucerne was started, and this cut will keep the drier employed until the middle of August.

To sum up, my cropping programme, designed to keep the drier working from the end of April to the end of September or later, is as follows :

Middle to end April	Winter rye
May to the first week in June	1st cut lucerne
Two or three weeks in the middle of June	Spring-sown rye or spring-sown cocksfoot
End of June to first week in August	2nd cut lucerne
Two weeks in middle of August	Drier shut down for harvest or drying pea haulm from canning factory
End of August and part of September	3rd cut lucerne and some cocksfoot
End of September and October	Aftermath from hayfields

LATEST DEVELOPMENTS IN WEED CONTROL

Professor G. E. BLACKMAN, M.A.

This Conference is largely concerned with herbage seed production, so I will try and talk about weeds in relation to herbage seed production and bring in some of the new materials which are available for selective weed control.

You will know that there are roughly four types of materials :

(i) Sulphuric acid
(ii) Copper salts
(iii) Growth-regulating substances, such as MCPA and DCPA
(iv) Nitro-compounds—for example, DNOC

There may be an opportunity for pre-emergence spraying against weeds coming up in advance of the crop. Up to now the only material that can be used for pre-emergence spraying is sulphuric acid. The reason you cannot use the others is that all these sprays leave toxic residues in the soil. In the case of sulphuric acid this is not so ; it combines with calcium and forms insoluble calcium sulphate. As an alternative to sulphuric acid, the present indications are that you can use emulsions of diesel oil, which are toxic to many weeds and do not appear to leave toxic residues. It is also possible that other oils which we have recommended for weed control in carrots may also be employed, but more research is yet required.

Although I don't think that pre-emergence spraying in either grass or clover seedbeds is likely to be a normal procedure, there are possibly other materials that can be used for these crops *after* emergence if they are sown direct and not with a cover crop. If you use a cover crop you simply cannot use diesel oils, as they are toxic to the cover crop once the plants are up. If you are sowing your seeds under cereals you must be quite certain that the materials you use will not damage your cover crop or the undersown crop. Grasses, as long as they are in the well-advanced seedling stage, can be sprayed with any of the four groups of compounds which do not damage the cereals. If the grasses are under linseed you cannot use sulphuric acid, or copper chloride ; the best thing is MCPA at the rate of 100 gallons (0.2 per cent solution) per acre. Selective weed control is simplest when grasses are grown alone for seed production, but you must wait until the grass has started to tiller before spraying or dusting. With the growth-regulating substances you can get a complete kill of the crop if you spray when the seedling grasses are just coming through the ground ; but when they have reached the seedling stage they are much more resistant. Do not use as much DNOC on grass as on cereals.

Difficulties occur with mixtures : S.23 and S.100 for example. Clover seedlings are not resistant to the growth-regulating substances or DNOC. They will withstand a little copper chloride, but not sulphuric acid. If you have a complete smother of charlock in an undersown crop the spray will probably remain on the charlock leaves and the undersown crop will be protected, and you can use low concentrations of MCPA, DCPA or DNOC. If there are not many weeds do not spray. You will be in trouble if the spray comes into direct contact with the clovers. Research in progress indicates that DNBP* is not as toxic as DNOC to some clovers, but no definite conclusions have yet been reached.

The other development which is coming along is the use of a diesel oil emulsion containing DNBP for the spring spraying of lucerne in the dormant phase for weed control. You can even stunt the grass weeds so that the

*Dinitro – butylphenol.

lucerne will grow away and smother them. There is some indication that there may be a little check to the lucerne with the first cut.

What about the more established grasses where the weeds are of the perennial rather than the annual variety? Growth-regulating substances here are outstanding. The other materials which kill annual weeds have no permanent effect on established perennial weeds. We have experimented with creeping thistle and find that control is all a question of timing. Wait until you see the flower-buds on the stems of the thistle, then spray at once. If you spray earlier the effect will be far less; if spraying is delayed, then again the results will not be so good.

In general, for weed control in fields of established grasses grown for seed, spray in the first half of May, no later. The grasses may be depressed if spraying is delayed beyond this point. The alternative is to cut the crop and spray in the autumn.

Docks can be a nuisance in grasses for seed. You can keep to this late April–early May spraying for seedling docks, or docks in the first flowering year, and get good results. The important point is that there should be a large leaf area at the time of spraying and that the docks should not be old plants.

Turning to buttercups, the creeping buttercup is more susceptible to treatment than crowfoot (*R. acris*). April spraying seems to give the best results. The position is more complicated with the bulbous type; the indications are that the ester-oil emulsion sprays at the flowering stage are the most effective, but the possible injury to grasses being shut up for seed has yet to be investigated, and the decrease in clovers may be very great.

OBSERVATIONS ON LUCERNE

WILLIAM ALEXANDER, M.B.E.
Eynsford, Kent

THE prolonged dry summer this year has again brought into prominence the value of lucerne to stock farmers, especially those with dairy cattle. The strange reluctance of farmers to put down greater acreages, where the land is suitable, can only be described as one of those things wrapped in mystery and beyond understanding. For it is only a matter of studying the requirements of the plant in the early stages; the remainder is plain sailing.

Type of land has first to be considered, and by dividing it into two classes we have soil on which lucerne will grow and the remainder on which it is hopeless trying to establish it. The first class has many subdivisions, varying from some fertile marshes where the land only requires cleaning, and the seed sowing; then, without any manuring whatsoever (but with suitable management) a stand of some 6 to 8 years is assured. At the other end of the scale, elaborate preparations have to be made during the years previous to sowing to work up the fertility to enable the crop to establish itself. Unfortunately, I am in a low fertility district, and I have often come away with a headache after visiting one of those favoured spots where things just grow.

Notwithstanding this, it is probably in the poorer districts where the greatest benefit is derived by making otherwise unprofitable land produce satisfactory crops. Establishing a ley after a well-dunged crop of roots is a very suitable place in the rotation. But if one has an awkward field which is too far away from the dung cart, or if dung happens to be scarce, there is no need to worry ; green manuring often gives equally good results. On suitable land the ordinary white turnip can give a good account of itself, and on chalky banks it has proved superior to mustard or rape. It has the great advantage of being cheap, and its quick growth enables the land to be cleaned both before sowing and after the crop is put under. June 15 has been found to be a suitable date for sowing (3 lb. per acre through a corn drill), and the turnips will come to maturity by the middle of September. If the manuring has been adequate a large quantity of organic matter goes into the soil. Sheep would, of course, make a nice tidy job, but in their absence a heavy disc harrow or rotary hoe achieves the object, which is to cut up the turnips so that they will not stay intact underneath the ground all winter and be a nuisance the following year.

Spring Wheat as Cover Crop Having got the land in good heart prior to establishing lucerne, we now consider the best method of obtaining a satisfactory plant. There is the strongest possible reason for sowing with a cover crop (not smother crop) of spring wheat about the last week in March or the first week in April. The argument in favour of this is that it is economic, and on my own farms the practice has never been known to fail. This year, for instance, at the time of cutting the wheat, the lucerne was 18 inches high and looking very happy. It is not advisable to aim at more than 4 to 5 qr. of wheat, which requires a thin plant not too heavily manured with nitrogen. The lucerne seed is sown directly after the wheat is sown, and they both come away together, having equal chance for food and light. To expect good results under a thick crop of winter wheat is just asking for trouble—and possibly resowing. The textbooks recommend sowing in early spring without a cover crop—a method which is quite satisfactory where the land can be guaranteed clean of annual weeds. But where there is an affliction of charlock, poppy, chickweed, fat hen and knotgrass, the only thing to do is to stir the land three times a month until the end of June or the beginning of July, by which time it may be considered clean and an excellent plant can be obtained. There is, however, no financial return in the year of sowing, and one has only to count the difference between that and 4½ qr. of wheat before thinking twice about adopting the latter method. It may be argued that a heavier crop will result from sowing without a cover crop, but considering that a stand sown under Atle wheat in 1948 yielded in three cuts 5 tons per acre of dried material in 1949, a pretty good case will have to be put forward.

For the commercial man who is growing just to dry and grind into meal, it is probably best to sow lucerne with, say, ½ lb. of wild white clover. Cleaning can be done in the winter by cultivation or by hard grazing in March. For the stockman, the addition of a suitable grass in the mixture is advisable. To those who say otherwise, I ask, why not grow red clover by itself instead of including ryegrass or other grass for a one-year ley? Lucerne grown by itself does not make an attractive fodder, it is not easy to make into hay on account of the loss of leaf, and cattle much prefer it mixed with some sort of grass. In some districts cocksfoot is given preference and it may be best under some conditions and on some soils, but on chalk it may well be that timothy is the answer. Being a late grass, it is at the right stage for making into early cut hay when lucerne is ready,

and if weather conditions delay cutting it does not run to a hard stalk as does cocksfoot; in fact it makes a delightful mixture which cattle eat with relish. Meadow fescue has also been found very suitable.

The most common fault is to sow too much grass in the mixture, and many a field has been spoilt in this way. With timothy, 2 lb. per acre is usually sufficient. Cocksfoot requires a special method of introduction which necessitates harvesting the wheat first, then broadcasting about 5 lb. per acre and harrowing in. The result is that little is seen of the cocksfoot in the first year of cutting, and the lucerne is allowed to establish itself without interference from the cocksfoot, which will show up in the second year of cutting. In the first year there is danger that lucerne will be unable to keep down natural grasses and that its yield will be low. An addition to the mixture of a small amount of broad red clover has been found to be very useful in making bulk without depressing the growth of lucerne: 2 lb. of broad red per acre has been found enough in some cases to double the yield.

Where lucerne is being sown in a field for the first time, inoculating the seed just prior to sowing may be regarded as a form of insurance to ensure a good "take," and it has in a great many cases meant the difference between success and failure.

The Importance of Manuring and Strain

Manuring depends entirely on the type of soil. A sample for analysis should be taken as a guide. Some soils will require lime and more lime, while in chalky districts it will probably be potash and more potash, and in some districts phosphate. It is not always recognized that the heavier the crop removed, the more fertilizer should be applied to make up for what has been taken away. The fact that the dry matter in lucerne may analyse from 3 per cent upwards of K_2O is an indication of what should be replaced. With an experiment on varying applications of potash, the control plot which received none practically faded out after two seasons.

When everything has been done in land preparations, manuring, sowing, etc., there still remains one very important item, namely, the choice of variety and strain. This can make a wonderful difference to the crop. During the war, when no choice of seed was possible, the failure of some strains is no doubt one reason why certain farmers have given up hope of success. In fact, some ghastly failures on my own farms made the selection and developing of a better strain a first priority. Although it is doubtful if seeding lucerne will ever be a commercial proposition, except possibly in a few favoured districts, results have shown it worth while, with very much heavier yields than from ordinary strains. The new French variety, Du Puits, is also giving promising results, and it is hoped that it will prove capable of lasting at least as long as other varieties.

With lucerne, we have a plant capable of maintaining soil fertility, suitable for best quality hay and silage, giving the best continuity of supply in dry districts for grass drying plants, and capable of producing more protein per acre than any other plant we grow. Yet it is not taken seriously by the majority of farmers. To those who call themselves farmers but continue to put lucerne down under any old conditions and then grumble about results, there is only one answer: "You have got what you asked for, why expect any more?"

SILAGE IN HERTFORDSHIRE, 1948

W. Lewis and A. Eden, M.A.
National Agricultural Advisory Service, Eastern Province

PRESENT-DAY shortages of feedingstuffs make it increasingly necessary for farmers in Great Britain to make full use of home-grown foods, and in this connection more and more are turning to silage-making as a means of providing a valuable source of food for their cattle over the winter months. Farmers have definitely become silage-conscious, largely as a result of publicity and demonstrations by officers of the National Agricultural Advisory Service and by the examples of their neighbours. Now that the principles of good silage-making are well established and becoming more widely known and appreciated, the difficulties with this form of conservation of fodder crops are much less than they were ten years ago, and experience shows that more and better quality silage is being made than ever before.

Quality in silage implies, first, a product which is free from appreciable waste, pleasant to handle and smell, and secondly, a material relatively high in feeding value, particularly in protein. For assessment of the latter, samples of silage are taken by District Advisory Officers of the N.A.A.S. and sent to the laboratory at the Provincial Centre, where they are analysed and reported upon for feeding value. In this way the Provincial Nutrition Chemist gets a comprehensive picture of the silage position in each county, and thus it is possible to watch the progress of the silage campaign and assess its general results.

In the Eastern Province during the autumn of 1947 it was decided to attempt an intensive survey of silage quality the following season in one county, by inspecting and analysing samples of all the silage made within that county. Hertfordshire was selected for this purpose, since there were a number of established silage-makers there and the burden of analytical work was not likely to exceed the resources available to deal with it. The County Agricultural Officer, Mr. R. Line, and his District Advisory Officers, Messrs. Dunnett, Scragg, Naylor, and Morley, were enthusiastic about the idea and promised wholehearted co-operation. Accordingly a campaign was arranged, aided by lectures and demonstrations, for the 1948 season, and plans were made for samples to be taken as the silage was being fed. The farmers were keen and responded well, and the sampling was carried out over a period of six months. By the middle of April, 1949, it was estimated that at least 90 per cent of the silage made in this county had been analysed, and in one district the actual known figure was 96 per cent. The silage which had not been sampled consisted either of surplus, which remained in unopened silos for use during the summer months, or was from very small silos where the silage had been used up before the county staff was notified. In 1946 the estimated amount of silage in the county was 3,000 tons; in 1948 the figure had risen to 7,000 tons, and in the current year there is little doubt that the figure has again risen considerably.

In all, about 140 samples were received, and for easy reference the following results are expressed on a percentage basis.

Crops Ensiled Classification of the various crops made into silage is not too simple a task, as the following considerations will show. Lucerne, for instance, is a most important crop in the eastern counties, owing to its capacity to withstand drought conditions It is frequently grown as a straight crop, but there is an increasing tendency to grow it with companion grasses, such as cocksfoot and timothy, and less frequently ryegrass is also included. All crops for silage containing lucerne have been

grouped together as lucerne mixtures. Again, it has seemed desirable to maintain some distinction between crops of pure grasses and those containing clover and other legumes, which have accordingly been classed as clover-and-ley mixtures. Oats-and-tares are, perhaps, the traditional silage crop, but on the heavier soils other cereals and legumes (e.g., beans) are often included in the mixture, and for the present purpose it has been decided to distinguish between the traditional mixture and that in which other cereals and legumes have been included. Occasionally, cereals, alone or mixed, are taken in the young stage in early spring for ensiling, particularly where they have been autumn-sown and become winter-proud. The following Table shows the percentage distribution of the silages between the various crops:

Silage Crop Distribution

		per cent
1.	Lucerne mixtures	19.2
2.	Grasses	8.8
3.	Clover-ley mixtures	26.5
4.	Oats-and-tares	16.9
5.	Cereal-legume mixtures	14.7
6.	Cereals (alone or mixed)	5.1
7.	Sugar beet tops	3.7
8.	Pea haulm and pods	2.2
9.	Miscellaneous	2.9

Thus lucerne crops comprised about one-fifth of the total silage, compared with one-quarter for the whole Province. Grass and ley mixtures comprised over one-third, oats-and-tares one-sixth, and mixed cereal-legumes about one-seventh of all the silages. The increase in pea-growing for canning purposes in the eastern counties has stimulated farmers to use the haulm residues from the viners for making into silage, and almost without exception the material is of high protein quality. The percentage of silage made from pea haulm in Hertfordshire is rather low compared with that for the whole Province, where nearly 10 per cent of the total silage received was made from this crop, but when the virtues of pea haulm silage are more fully appreciated there will, doubtless, be a considerable increase in silage of this type. In view of the large acreage of sugar beet grown in the Province, it is surprising to find such a small amount of tops made into silage. Most of the tops, however, used for stock-feeding purposes are fed in the comparatively fresh condition, and quite probably the difficulty of getting the necessary labour during the busy sugar beet harvesting season helps to account for the low proportion of sugar beet top silage normally made in this area.

Type of Fermentation Each sample of silage received was accompanied by a report on the efficiency of the making process, and was further assessed in the laboratory. The types of fermentation were distributed as follows:

	per cent
Well-made or satisfactory	82.3
Underheated	2.2
Slightly overheated	8.1
Overheated	5.9
Mouldy or putrefying	1.5

The percentage of samples that were slightly or badly overheated was much higher than that for the Province as a whole, but it must be remembered that in carrying out the survey the samplers attempted to get *every* silo sampled, so that materials which normally do not find their way to the laboratory were examined to complete the records. Despite this, practically

90 per cent of the total silage was in fair-to-good condition from the fermentation aspect, and, where the poorer types of silage were met with, Advisory Officers did very useful educational work by pointing out where the faults in making had occurred and how they could be avoided in future.

Quality Evaluation All silage received was analysed for dry matter content, *p*H values (acidity), and crude protein content of the dry matter. The conventional system of classifying the silage on the protein basis was then followed, protein values above 15 per cent being taken as high, 12-14.9 per cent as medium, and below 12 per cent as low. Where marked overheating of the silage had occurred, resulting in lowered digestibility of the protein, such materials were classed as low, irrespective of their actual analysis.

Distribution of Protein Quality

	per cent
High	39.8
Medium	35.3
Low	21.3
Low through overheating	2.9
Mouldy	0.7

Thus practically 40 per cent of the silage made in Hertfordshire in 1948 was sufficiently high to be assessed as balanced for milk production, and less than 25 per cent was suitable for maintenance purposes only. If one takes the figure of 7,000 tons of silage made in the county and assumes an average dry matter content of 21 per cent, this high percentage of best quality silage was equivalent in milk production nutrients to practically 300,000 gallons of milk, or over 500 tons of balanced cake. This figure does not take into account the partial cake-substitution value of the medium protein silage. These figures illustrate the increasing part that silage is playing in the feeding-stuffs economy of dairy cows during the winter months.

Dry Matter and Acidity Values For record purposes and from the point of view of general interest, the distribution of the figures obtained for dry matter and *p*H values (acidity) are also given. Over 60 per cent of the silages received had dry matter contents ranging from 15 to 23 per cent; outside this range the silage was either obviously very wet, with the moisture readily expressed by gentle squeezing, or else rather dry so that moisture could not be squeezed out except with considerable difficulty. The mean value for all the dry matter figures was very close to 21 per cent, and at this figure for a well-made, high protein silage 20-25 lb. of the silage would provide sufficient nutrients for the production of a gallon of milk.

Dry Matter	Distribution	*p*H Value	Distribution
per cent	*per cent*		*per cent*
Under 15	3.7	Under 3.6	3.7
15.1 to 19	26.4	3·6 to 3.9	16.2
19.1 to 23	34.0	4.0 to 4.5	23.5
23.1 to 27	21.3	4.6 to 5.1	28.0
27.1 to 31	11.7	5.2 to 5.7	21.2
Above 31	2.9	Above 5.7	7.4

The *p*H figures are also interesting in that nearly 60 per cent of the values lay above *p*H 4.5. It is still held by some authorities that a *p*H figure exceeding 4.5 is indicative of a butyric type of fermentation, and values above 5.0 are said to suggest a definitely underheated silage and faulty making. In our experience, although these limiting values appear to be true

for oat-and-tare silage, we are reluctant to believe they are applicable to all types of silage. With the high protein types of silage from predominantly clover types of ley, and particularly with lucerne mixtures, it is extremely rare to get a *p*H value of under 4.6, and not often does the value fall below 5.0. In fact, with most lucerne types of silage (and 25 per cent of the silage made in East Anglia is of these types), which are almost invariably molassed liberally when made, it is unusual to get a *p*H figure of less than 4.9, and the general run is from *p*H 5.0 to 5.4. Above this value the odour of silage is very strong and cheese-like, and the butyric acid becomes more pronounced as the *p*H value increases.

We do not think that it is possible to specify the type of fermentation from a determination of the *p*H value alone; the figure has to be taken into consideration with the type of crop from which the silage is made. It is obvious that a good deal more fundamental work is necessary with these predominantly leguminous types of silage, and since in the eastern counties protein foods are scarce, most farmers are taking to ensilage as a means of conserving material of as high quality as possible.

In ensiling such crops as young clover and lucerne, it is necessary to be liberal with molasses, and a minimum allowance of two gallons, suitably diluted, is essential for the fermentation to be reasonably satisfactory, particularly when the crops are very sappy and have not yet reached the flowering stage. Our experience suggests that it is possible to begin ensiling a leguminous crop at too early a stage of growth, especially early in the season, and, contrary to the general advice for most types of silage, excessive consolidation of very young material should be avoided.

It should be pointed out that the silage examined in the county survey reported upon here was made in all types of silo—tower, pre-cast concrete, clamp, pit and stack. Provided the rules of good silage-making are followed, the type of silo appears to be immaterial; the emphasis is upon what is available and what is practicable on each individual farm. We do seem to have experienced a higher proportion of waste in the sectional concrete types of silo, where no attempt had been made to exclude air at the sides by sealing the joints in the concrete, and owing to the tendency of all silage to settle, it is often very difficult to make an effective protection against the weather and against waste at the top of the silo as the material settles down. Moreover, as in 1948 there was a cool, wet summer, on the whole stack silage appears to have been less prone to overheating than in the hot, dry summer of 1947.

The Hertfordshire survey has shown that not only is silage-making on the increase, but that higher feeding quality silage is being made. From the educational aspect satisfactory reports, not only analytically, but in the form of practical results obtained with livestock and in milk production, have encouraged farmers to go ahead with plans for more silage; adverse reports have been accompanied by suggestions of how to avoid obvious errors in future. The enthusiasm of the county staff and the ready co-operation of the farmers have contributed very materially to securing the information given in this article. The growing realization of the part that silage is playing and can play is helping towards greater self-sufficiency on our farms, and hence silage is making a very valuable contribution to the national economy in the difficult times through which we are at present passing.

PIG-FEEDING TRIALS AT WYE WITH FODDER BEET

INTERIM REPORT

A. C. DUNKIN, B.Sc. (Agric.) and Professor M. M. COOPER
Wye College

THE physiological limitation of a simple stomach of comparatively small capacity prevents the pig from making efficient use of a ration containing a high proportion of very watery foods. Thus root crops such as mangolds and swedes, with a dry matter content of 9.13 per cent, while useful particularly in limited quantities for breeding stock, are unsuitable for pig feeding on a heavy scale. Potatoes, sugar beet and certain varieties of fodder beet, on the other hand, are approximately twice as concentrated, having a dry matter content varying from 19 to 24 per cent. While, however, potatoes are generally acknowledged as an excellent fattening food, the beets, with a dry matter content only slightly less than that of potatoes and with a similar low fibre content, have been far less widely used for pig feeding. On the basis of yield of food nutrients per acre, which is becoming an increasingly important yardstick, a 19-ton crop of fodder beet of 20 per cent dry matter yields twice as much dry matter per acre as an 8-ton crop of potatoes and is equivalent in this respect to a 29-ton mangold crop of 13 per cent dry matter.

In contrast to mangolds, which require a storage period to complete maturation, roots of the sugar beet type can be pulled and fed direct; so that by early sowing a constant supply of beet may be available from September onwards. The value of the tops in early autumn is considerable, and when the whole plant is fed at this time, it helps to narrow the overall nutritive ratio by reason of a higher protein content.

So much for the theoretical advantages of the high dry matter beets which, together with the encouraging results of some New Zealand feeding trials with sugar beet (1), led us to start a series of trials with fodder beet at Wye in 1947-48. In parenthesis it should be emphasized that the following trials relate only to a high dry matter fodder beet, since very appreciable varietal differences in respect of dry matter content occur, some varieties of fodder beet having a dry matter content comparable only with that of mangolds.

Following a small-scale plot experiment in that year, using beet of the Danish variety Hunsballe, further trials were carried out in 1948-49 with this same variety. Table 1 gives details of root and dry matter yields obtained, and for comparison, the corresponding figures relating to a four-year series of Danish trials recently reported are also included (2).

Table 1. Crop Yields of Hunsballe Beet

	Roots *tons per acre*	D.M. Content *per cent*	Dry Matter *tons per acre*
Wye 1947	22.2	20.6	4.56
Wye 1948	18.8	20.0	3.76
Danish trials	19.7	20.3	4.00

1947-48 Trial Using Large White and Large White × Essex stores of 120-125 lb., five lots of litter mates paired for sex and weight were allocated to two treatments:

Treatment I. Control. All meal feeding, according to the scale given below.

Treatment II. 3 lb. per head daily of a basic meal mixture containing 20 per cent fishmeal, plus fingered beet to appetite.

PIG-FEEDING TRIALS AT WYE WITH FODDER BEET

Meal Mixtures

	Treatment I	II
Barley meal	65	60
Fine millers' offals	30	20
White fishmeal	5	20
	100	100

Feed Scales—Control Pigs

100 lb. live weight	5 lb. meal
140 „ „ „	6 „ „
160 „ „ „	6½ „ „
180 „ „ „	7 „ „
200 „ „ „	7½ „ „

Pigs were fed individually and weighed weekly. During a preliminary four-week period the meal allowance of the beet pigs was gradually reduced to 3 lb. as beet consumption rose; at the same time, the fishmeal content of the meal mixture was gradually increased from an initial 5 per cent to 20 per cent. In this way an attempt was made to balance the intake of total nutrients by both groups, the deviation in weight between pairs at the close of this preliminary period indicating the extent to which this was successful. For a similar reason, the controls' meal allowance was increased to a maximum of 7½ lb. at 200 lb. From the third week and throughout the six-week experimental period it was necessary to adopt three times daily feeding, since daily beet intake rose to a maximum of 20 lb. From a weighed day's supply, approximately one-third of the meal and beet allowances were mixed together with a little water at each meal. On Sundays only two feeds were given, amounting to two-thirds of a normal day's ration.

Table 2. Liveweight Gains (lb.)

Block	Initial Live Weight		Final Live Weight		Total Gain		Average Daily Gain	
	Treatment I	II	I	II	I	II	I	II
1	147	144	209	206	62	62	1.51	1.51
2	151	152	207	209	56	57	1.37	1.39
3	151	149	211	211	60	62	1.46	1.51
4	164	159	209	211	45	52	1.10	1.27
5	169	169	233	220	64	51	1.56	1.24
Mean	156.4	154.6	213.8	211.4	57.4	56.8	1.40	1.39

Table 3. Food Consumption and Economy of Gains (lb.)

Block	Total Meal		Total Beet		Meal per 1 lb. Gain		Beet per 1 lb. Gain	
	Treatment I	II	I	II	I	II	I	II
1	263	117	—	694	4.24	1.89	—	11.2
2	263	117	—	708	4.70	2.05	—	12.4
3	263	117	—	712	4.38	1.89	—	11.5
4	270	117	—	691	5.99	2.25	—	13.3
5	277	117	—	694	4.32	2.30	—	13.6
Mean	267.2	117	—	699.8	4.65	2.06	—	12.31

Treatment II pigs took to the beet very readily and appeared to find it highly appetizing, no refusals being recorded during the 41 days of the trial period, though a considerable time was required to clear up the large amounts of beet offered, each meal lasting an average of 40 minutes and up to an hour in some cases. Both groups remained in good health throughout the trial and, although the dung of the beet-fed pigs was softer and persistently darker in colour than that of the controls, no scouring occurred. At the end of the trial the controls appeared to carry rather more bloom.

Liveweight gains for both groups were very satisfactory, with a difference in total gain for the two groups of only 3 lb. This difference was not significant at the 1 per cent point. Food consumption figures indicate that an average intake of 6¼ cwt. of beet saved 150 lb. of meal, giving a meal equivalent value for beet of 4.7 lb., and representing an economy of 56 per cent on the amount of meal eaten by the control pigs.

Carcass measurements on 8 pigs failed to disclose any treatment difference in respect of backfat or belly thickness, while firmness of fat was equally good in both groups.

1948-49 Trials :
I. Individual Feeding Experiment A further trial took place from December, 1948, to April, 1949, in which the two previous treatments were repeated (No. I and II below). In addition, since 20 per cent fishmeal in the basic meal appeared an adequate upper limit, and in view of Woodman's conclusions regarding the adequacy of a meal containing 10 per cent fishmeal fed in conjunction with steamed potatoes (³), a third treatment was added in which 3 lb. of meal mixture containing only 10 per cent fishmeal were fed together with beet to appetite.

All pigs were Large Whites of about 95 lb. at the outset, comprising five blocks each of three litter-mates. Random allocation of pigs within blocks to the three treatments gave an experiment of randomized block design with five replications. Feeding scale, meal mixtures I and II, and food preparations were similar in all details to those of the previous trial. Whereas, however, in the 1947-48 trial pigs had been housed in covered sties with small open yards, each accommodating five pigs, in the second trial all the pigs were housed together in an open yard, with covered sleeping quarters and equipped with individual bails for feeding. After a preliminary period similar to that of the previous trial the experiment ran for ten weeks, with three times daily feeding starting at the end of the preliminary period.

Table 4. Liveweight Gains (lb.)

Block	Initial Live Weight			Final Live Weight			Total Gain			Average Daily Gain		
	Treatment			Treatment			Treatment			Treatment		
	I	II	III	I	II	III	I	II	III	I	II	III
1	140	137	133	232	235	214	92	98	81	1.31	1.40	1.16
2	138	139	135	229	217	210	91	78	75	1.30	1.11	1.07
3	125	126	124	217	220	185	92	94	61	1.31	1.34	0.87
4	127	127	110	221	218	181	94	91	71	1.34	1.30	1.01
5	124	126	124	210	217	206	86	91	82	1.23	1.30	1.17
Mean	130.8	131.0	125.2	221.8	221.4	199.2	91.0	90.4	74.0	1.30	1.29	1.06

Table 5. Food Consumption and Economy of Gains (lb.)

Block	Total Meal			Total Beet			Meal per 1 lb. Gain			Beet per 1 lb. Gain		
	Treatment			Treatment			Treatment			Treatment		
	I	II	III	I	II	III	I	II	III	I	II	III
1	445	195	195	—	1152	1085	4.84	1.99	2.41	—	11.75	13.39
2	444	195	195	—	970	1035	4.88	2.50	2.60	—	12.44	13.80
3	422	195	195	—	1062	815	4.58	2.07	3.20	—	11.29	13.36
4	434	195	195	—	1006	893	4.62	2.14	2.75	—	11.06	12.58
5	426	195	195	—	990	1001	4.96	2.14	2.38	—	10.88	12.21
Mean	434.2	195	195	—	1036	965.8	4.77	2.16	2.64	—	11.46	13.05

It will be observed that the general performance of pigs in this second trial was slightly inferior to those in the 1947-48 trial. This might be at least partly accounted for by the more exposed nature of the accommodation and the greater freedom of movement in the second trial. The results of Treatments I and II were again in very close agreement however. Differences in gains between Groups I and II were not significant at the 1 per cent point, but both were significantly greater than Group III.

Beet consumption by pigs in Blocks 3 and 4 of Treatment III was subnormal even during the preliminary period, but, in general, daily gains for this group are seen to be appreciably less than for the others. In addition to these two pigs, Block 2 of Treatment II was consistently below the average in rate of beet consumption and, although this again reached a maximum of 17½-21 lb. daily, the appetite of the beet pigs appeared to be exceeded more easily than was the case in the first trial, while the overall incidence of food refusals was much higher. Scouring was observed in certain of the beet pigs from time to time, especially in the three pigs already mentioned, but it was not sustained, except for Treatment III pigs in Blocks 3 and 4.

A comparison of food consumption figures for Groups I and II reveals that a saving of 55 per cent of meal was achieved over the ten week period by the feeding of 9¼ cwt. of beet, representing a meal equivalent value for beet of 4.33 lb. The significantly lower performance of Group III precludes a similar comparison.

II. Group Feeding In order to obtain information as to the practicability of using fodder beet for fattening under commercial conditions, five groups, each containing five baconers of 120-135 lb., received uncleaned beet that had been roughly chopped with a spade, in place of part of their meal allowance for a period of nine weeks. No attempt was made to feed beet as heavily as in the individual feeding trials, the beet being given alone at midday and followed by a reduced meal feed in the afternoon. The replacement ratio used was 5 lb. uncleaned beet to 1 lb. meal. Starting at 10 lb. per group daily, the beet allowance was increased gradually to 40 lb. after five weeks. A similar meal mixture to the one used for the control group in the previous experiments (i.e., containing 5 per cent fishmeal) was used throughout.

Table 6. Summary of Results (lb.)

	Group (5 pigs each)					Average
	I	II	III	IV	V	
Total initial weight	695	587	603	720	683	657.6
Total final weight	1083	1005	988	1126	1090	1058.4
Total gain (9 weeks)	388	418	385	406	407	400.8
Average daily gain per pig	1.23	1.32	1.22	1.29	1.29	1.27
Meal consumption	2008	1866	1866	1976	1957	1934.6
Beet ,,	1732	1689	1732	1732	1732	1723.4
Estimated percentage saving in meal	18.8	18.6	19.9	16.7	18.7	18.5

Liveweight gains were moderately good, though slightly less than might have been expected on all-meal feeding. Performance, however, was in close agreement with those pens of meal-fed baconers of approximately the same initial weight.

Discussion of Results The results of these first two series of trials, in failing to disclose any significant difference in length of fattening period when half the dry matter of the ration was provided by beet, fed in conjunction with a high protein basic meal, suggest the useful contribution which high dry matter beet is capable of making to our supplies of home-grown starchy foods suitable for pigs. Rather poorer results, including a wider meal replacement ratio, have been reported in similar Danish trials with sugar beet (4), but the initial live weight in these tests was 65-75 lb., compared with weights of 125 and 95 lb. respectively in the trials here reported. Incomplete data on a number of beet fed pigs maintained on the experimental treatments until 250 lb. indicate some falling off in rate of gain after about 220-230 lb. From this fragmentary evidence, together with the Danish results, it seems that normal fattening can be expected only with heavy beet feeding over a limited weight range, and that care must be taken over the gradual introduction of beet into the ration.

As regards the minimum level of protein necessary for rapid growth and fattening, Treatment III of the 1948–49 trial has supplied little information on this point, since the poor growth of two pigs, almost from the outset, cannot definitely be attributed to the lower fishmeal content of their ration. In view of a maximum daily gain of only 1.17 lb. in this group, however, it does appear that the 10 per cent fishmeal level is barely adequate. While stressing the need for further investigation, preliminary results suggest that the minimum level of fishmeal for normal growth lies between 10 and 20 per cent.

Economic Considerations. Of prime interest to the practical man is the comparative cost of beet feeding in relation to the cost of other available foods. Wyllie, in a report on production costs and financial results for root crops (5), draws attention to the very wide variation in cost per ton of roots, especially mangolds, both between individual farms and from season to season. He emphasizes the futility of employing average results in trying to decide whether a particular crop is worth growing. Applying this principle to the growing of fodder beet, it is clear that its economic feasibility is primarily determined by the cost per acre for which any farmer can grow fodder beet and by the yield per acre he can reasonably expect

to obtain over a number of years. It is suggested, however, that provided a combination of these factors enables beet to be grown and stored for an overall cost per ton slightly less than the current price for stock-feed potatoes, then total feeding costs will compare favourably with those for potatoes, since the poorer meal replacement value of beet is practically offset by the additional cost involved in steaming potatoes.

Without attempting to minimize the very real value of potatoes for pig feeding, it is pointed out that the crop is subject to heavy seasonal fluctuations in yield. In such circumstances the farmer growing only a small acreage of potatoes, but who is also fattening pigs, might conceivably find a small acreage of fodder beet a useful insurance.

It appears that fodder beet has appreciable commercial possibilities, as an alternative to potatoes in individual cases where the latter are unsuitable or, in general, when supplies and prices of potatoes for stock-feeding are unfavourable.

Perhaps the greatest application of fodder beet feeding, however, will prove to be for pregnant and growing breeding stock, especially when yarded or run out on pasture. So far this important aspect has not been tackled, but now, having obtained some indication of the feeding value of beet for fattening pigs, it is hoped to gain experience of its use with breeding gilts and sows, in addition to acquiring further information as to the optimum protein level of the ration and the economics of beet feeding to various classes of pigs.

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FODDER BEET FOR FATTENING PIGS

COMPARISON WITH MANGOLDS

R. Braude, Ph.D. and K. G. Mitchell, B.Sc.

National Institute for Research in Dairying, Shinfield, Reading

AN experiment was carried out at the National Institute for Research in Dairying for the purpose of providing a live pigs exhibit at the Royal Counties Show at Sonning in June, 1949. The objects of the exhibit were to demonstrate that home-grown roots could be used successfully in the ration of fattening pigs with a considerable saving of meal, and to compare the value of fodder beet, a root crop only recently introduced into this country, with mangolds. The exhibit aroused great interest, and it was decided to make a full report of the experiment.

The shortage of meal available for pig feeding during and since the war has made the inclusion of other types of foods in the ration of the pig a necessity for the majority of pig-keepers. Such bulky foods as mangolds, potatoes and swill have been widely used for this purpose. Provided these are fed in conjunction with a small quantity of a properly balanced meal, satisfactory results can be obtained. The complete ration must not only

provide protein, carbohydrates, minerals and vitamins in amounts needed by the pig, but also its bulk must be limited so as to allow the pig, with its comparatively small stomach, to consume and digest sufficient to cover its nutritive requirements. A method of feeding these bulky foods in general use is called the Lehmann system, which consists of feeding a small, fixed quantity of meal throughout the fattening period, supplemented by the available bulky foods fed according to appetite.

Experimental The experiment was designed to show the importance of using a correct basal meal and, at the same time, to compare the value of fodder beet with that of mangolds as the supplementary food. The Lehmann system of feeding was used, the experimental pigs being given 2½ lb. daily of a basal meal throughout the fattening period, plus the supplementary food fed according to appetite. Control pigs received an all-meal ration.

Table 1. Composition of Meals Used

	Meal Mixture		
	A	B	C
Wheat offals	30	28	28
Barley meal	35	35	44
Crushed tail-wheat	–	20	20
Flaked maize	23	–	–
Dried grass	2	2	–
Fishmeal	10	15	–
Meat and bone meal	–	–	5
Decorticated groundnut cake	–	–	3
Cod liver oil	*	*	–
Percentage crude protein	16.3	19.7	13.4
Approximate price per cwt.	25s. 6d.	26s.	23s. 3d.

*Approximately 30 g. per pig added once weekly directly into the troughs.

There were four treatments, and six pigs were placed at random on each treatment. A single experimental unit consisted of four pigs as similar as possible at the beginning of the experiment. As twenty-four home-bred Large White weaners (11-13 weeks old) from three litters were all available at one time, each group of six pigs receiving the same treatment were placed together in a large pen which contained six small pens for individual feeding. The pigs were shut into these individual pens at feeding time and were let out together in the large pen for the remainder of the day and night.

The pigs were weighed weekly throughout the experiment, and an estimate of any food refused was made daily for each pig. The experiment was started on February 21, 1949, and continued for 17 weeks.

The varieties of the roots used were Intermediate Red mangolds and Danish fodder—sugar beet, White Øtofte. The mangolds contained 9.1 per cent and the fodder beet 21.3 per cent dry matter. The meal mixtures used in the experiment are given in Table 1. Sufficient quantities of them were mixed before the experiment was started to last for the whole experimental period. The four experimental treatments were as follows:

PEN. 1. Controls. The six pigs in this pen received Meal A throughout, the quantity given being based on live weight and a scale for fattening pigs (cf. Braude and Foot; 1942). The meal was fed twice daily as a wet mash, 3 lb. of water being allowed for each 1 lb. of meal.

PEN 2. The pigs in this pen received Meal C as a wet mash, on the same scale as the control pigs, until at 50 lb. live weight each pig was receiving 2½ lb. daily. This quantity of meal was then kept constant, and raw, sliced mangolds were introduced, the amount given being adjusted according to appetite. Six pints of water were added per day to allow for the 2½ lb. of meal in the ration.

PEN 3. The pigs in this pen received Meal B, otherwise they had the same treatment throughout as those in Pen 2.

PEN 4. Meal B was also given to the pigs in this pen in the same manner as for the pigs in Pen 3, but in place of mangolds, raw, sliced fodder beet were given.

The pigs in Pens 2, 3 and 4 were fed twice daily until they had been receiving the roots for about 10 weeks. By then appreciable quantities were being consumed and it was decided to feed three times a day—at 7.30 a.m., 11.45 a.m. and 4.0 p.m.

At the end of the experimental period (June 20) the average daily consumption of roots per pig was as follows :

Pen 2	24.0 lb.	mangolds
Pen 3	28.9 ,,	,,
Pen 4	18.3 ,,	fodder beet

With these large quantities of roots, the pigs took twice or three times as long as the control pigs to eat their food.

Results and Discussion All the pigs on test, with one exception, were in good health throughout the experimental period, and within each group they grew at a consistent rate. Pigs receiving a large proportion of roots in their diet had very soft dung, and this was more pronounced in the pigs which received mangolds than with those receiving fodder beet. During the week beginning May 9, one pig in Pen 2 was observed to be unwell and was refusing food. It appeared to have difficulty in walking and would not get up unless forced to do so. It lost 18 lb. in weight in the course of a few days and had to be excluded from the experiment. It is, however, of interest that after only a week on a good all-meal diet, supplemented with cod liver oil, the pig recovered and thereafter made normal growth. It is thus possible that the cause of the trouble was vitamin A deficiency.

The results of the experiment are summarized in Table 2 and in the diagram, the latter showing the mean growth curves for pigs in each group.

Comparison of the results for pigs in Pens 2 and 3 shows that the rate of growth and the efficiency of food utilization of the pigs in Pen 3 were significantly better than those of the pigs in Pen 2. Since both lots of pigs received mangolds as the supplementary food, the differences recorded were obviously due to the different basal meals fed. Basal Meal B received by the pigs in Pen 3 was designed to provide all the nutrient required for normal growth when fed in conjunction with the supplementary food, whereas no such attempt was made in respect of basal Meal C received by the pigs in Pen 2. The complete ration of the latter was deficient in protein, at least in the early stages of the experimental period, and also deficient in some minerals and vitamins. These results demonstrate the importance of ensuring that the basal meal fed with the roots on the Lehmann system is properly compounded to supply all the required nutrients.

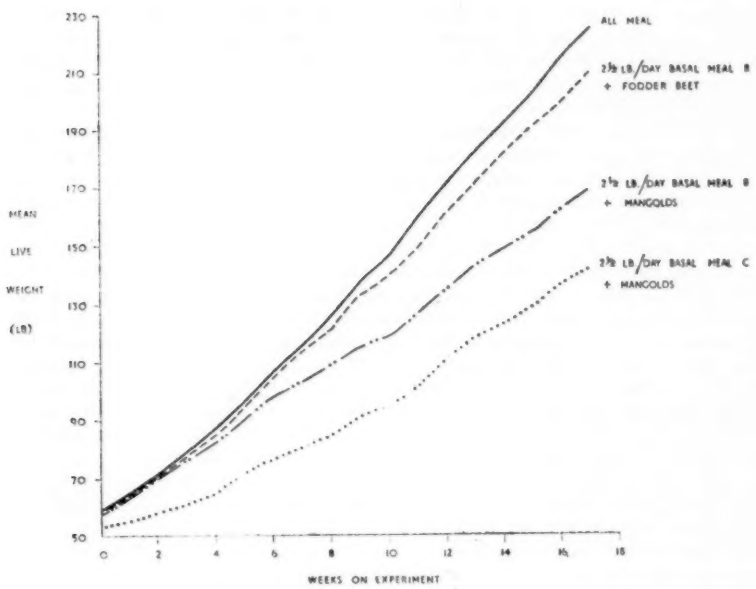
By comparing results for the pigs in Pens 3 and 4, both of which received the good basal Meal B, the value of fodder beet, as against mangolds as the bulky supplementary food, is demonstrated. The rate of growth and the efficiency of food utilization of the pigs receiving the fodder beet were greatly superior to those of the pigs receiving mangolds.

It has already been mentioned that the dry matter content of the fodder beet was more than double that of the mangolds (21.3 per cent as against 9.1). As analyses have shown, this difference in dry matter is due mainly to the percentage of soluble carbohydrates of which a considerable proportion (up to 85 per cent) in the fodder beet is present as sugar. Although this high sugar content probably accounts for part of the superiority of the

Table 2. Average Liveweight Gain and Food Consumption Figures for the Four Experimental Groups

Mean Weight *lb.*	Pen 1	Pen 2*	Pen 3	Pen 4
	All meal (Control)	2½ lb. per day basal Meal C +Mangolds	2½ lb. per day basal Meal B +Mangolds	2½ lb. per day basal Meal B +Fodder Beet
Initial	58.8	53.2	58.7	58.3
After 119 days	224.0	142.0	169.2	209.7
Gain	165.2	88.8	110.5	151.3
Daily gain	1.39	0.75	0.93	1.27
Meal consumed per lb. liveweight gain	3.58	3.35	2·69	1.97
Roots consumed per lb. liveweight gain	–	13.85	16.21	9.00

*The figures for Pen 2 are the mean of five pigs only—see p. 371.



Mean growth curves for pigs receiving the four experimental treatments.

fodder beet, there can be no doubt that the lower moisture content, and hence reduced bulkiness of the beet, was a major factor responsible for the better growth of the pigs in Pen 4. The pigs receiving the fodder beet as supplement were able to consume quite comfortably a sufficient quantity of them to supply enough dry matter and nutrients required for normal growth. On the other hand, it will be seen from the diagram opposite that when pigs receiving the mangolds reached about 100 lb. live weight they were unable to consume enough dry matter from mangolds to satisfy their requirements, owing to their rather limited stomach capacity, and accordingly their rate of growth gradually declined.

These results provide a striking demonstration of the importance of limiting the bulkiness of the ration fed to the pig. Failure to do so results in a considerably slower rate of growth and a very much lowered efficiency of food utilization. Some years ago Braude and Foot (1942),* using the Lehmann system of feeding, obtained much better results with mangolds as the supplementary food by mixing them with biscuit waste (6 parts of mangolds to 1 part of biscuit waste). This had the effect of lowering the bulkiness of the complete ration with the consequent better results. A similar effect could be obtained by increasing the amount of the basal meal fed daily from 2½ to 3½ lb. per head. Alternatively, the addition of 1 lb. per pig daily of home-grown ground grain (e.g., barley, oats, tail-wheat) would help to reduce the bulkiness of the ration containing mangolds.

The value of fodder beet as the supplementary food to a good basal meal on the Lehmann system can be judged further by a comparison of the results for the pigs in Pen 4 with those for the control pigs in Pen 1, which received a good all-meal diet. The figures in Table 2 show that the mean liveweight gain of the control pigs during the whole experimental period was 13.9 lb. greater than that of the pigs receiving the fodder beet. As regards food utilization, the pigs in Pen 4 consumed on the average 1.61 lb. of meal less for each 1 lb. liveweight gain than the controls, but in addition to the meal consumed 9.0 lb. of fodder beet for each 1 lb. of gain. To make a more direct comparison, the mean dry matter consumption per 1 lb. liveweight gain has been calculated : pigs in Pen 1 consumed 3.12 lb. while those in Pen 4 consumed 3.63 lb. of dry matter for each 1 lb. liveweight gain. The control pigs were therefore rather more efficient in the use of dry matter than the pigs receiving fodder beet. However, taking into account the additional energy required for mastication and digestion of a very much larger bulk, the results for the fodder beet pigs must be regarded as entirely satisfactory. It is also interesting to compare the two groups on a "meal" basis. The fodder beet consumed by the pigs in Pen 4 may be considered to take the place of the difference in meal consumption between the control pigs and those receiving fodder beet. On this basis it is found that 5.6 lb. of fodder beet are equivalent to 1 lb. of meal.

The real value of the use of fodder beet in the diet of the pig lies in the large saving of meal that it makes possible. Thus the mean total consumption of meal per control pig was 591.9 lb., as against 297.5 lb. for a pig receiving fodder beet, a saving of 294.4 lb. or approximately 50 per cent. It should be borne in mind that at the end of the experimental period the control pigs had gained an average of 13.9 lb. per pig more than those receiving fodder beet. Therefore for a really strict comparison of the saving of meal to be made, the extra ten days or so that would be required for the fodder beet pigs to make the same gain as the control pigs should be taken into

*Braude, R. and Foot, A. S. *J. Agric. Sci.* (1942), **32**, 70.

account. As this would, at the most, mean an extra consumption of only 25 lb. of meal per pig, the saving of meal over the whole fattening period remains very substantial.

In addition to the meal-saving aspect, the financial returns obtained are of great practical importance. Taking current prices for meal and fodder beet at £4 a ton, the average cost of food consumed by each pig in Pens 1 and 4 during the fattening period was £6 14s. 8d. and £5 17s. 11d. respectively. Although the labour costs per pig would be slightly higher for those fed on roots, it is obvious that a reasonable profit would be made for pigs in both groups.

After slaughter the carcasses of the control pigs and of the pigs which received fodder beet were examined by expert graders at the bacon factory and samples of loin fat were sent to Dr. E. H. Callow, of the Low Temperature Research Station, Cambridge, for determination of the Iodine Number. The points allocated by the graders were very similar for the two groups and put all the carcasses in high quality grade. There was some indication, however, that the fat was firmer in the carcasses of pigs which received fodder beet. This was confirmed by the Iodine Numbers, which are given in Table 3. Thus the value of the carcasses for bacon-curing from the fodder-beet-fed pigs was higher than that of the all-meal-fed pigs. The high proportion of flaked maize in the ration of the latter was probably mainly responsible for the softer carcass fat.

Table 3. Iodine Number of Loin Fat

Sample	Control Pigs		Fodder Beet Pigs	
	Outer Layer	Inner Layer	Outer Layer	Inner Layer
1	74.5	62.2	63.5	54.9
2	72.6	62.9	63.5	55.4
3	72.6	63.9	65.3	55.2
4	73.7	63.3	61.4	55.6
5	70.1	57.9	63.4	55.2
6	74.4	65.1	65.4	54.3
Mean	72.98	62.55	63.75	55.10

Summary 1. An individual feeding experiment using twenty-four pigs was carried out with the object of demonstrating that bulky, home-grown roots could be used successfully in the ration of fattening pigs on the Lehmann system, provided they were fed in conjunction with a properly balanced meal.

2. The value of fodder beet as a supplementary food was found to be greatly superior to that of mangolds.

3. The growth rate of pigs which received fodder beet and the efficiency with which they utilized their diet was only slightly inferior to those of pigs which received a whole meal diet. An equally satisfactory profit per pig was obtained on both diets.

4. The quality of the carcasses from the pigs fed fodder-beet was better than that from the pigs fed meal only, the fat of the former being much firmer.

We wish to thank Mr. A. S. Foot, the Head of the Dairy Husbandry Department, for his interest in this experiment, and Dr. E. H. Callow and his colleagues for the determination of the Iodine Numbers. We are also indebted to the Directors of Messrs. M. Venner and Sons, Ltd., Bacon Factory, Reading, and their General Manager, Mr. E. Gunson, for the facilities provided and help given during the slaughter and grading of the experimental carcasses.

FARMING IN THE SHETLANDS

ALLAN FRASER, B.Sc., M.D.
University of Aberdeen

NORTH of Scotland there are two large groups of islands, the Orkneys and the Shetlands; the Fair Isle, "the Island of Sheep," lies half-way between. The Orkneys are within sight of the mainland of Scotland; the Shetlands are a full day's sailing further north. Both groups of islands were for many centuries dependencies of Norway. That is important in the understanding of the place-names, the people, and their agriculture. The place-names are all Norse. There has been no Gaelic spoken in these islands within historical times. The people are of Scandinavian descent and have carried some of the farming energy of Scandinavian peoples with them across the seas. That farming energy is more obvious in Orkney than in Shetland, simply because the soil of the Orkneys is much more suitable for agriculture. The land of much of the Orkneys is good, deep, productive land, responsive to high farming. By contrast, Shetland is barren, rocky, and less profitable to farm. Both groups of islands are deeply indented by the encircling sea, rich in sea-harvest. In both, the claims of fishing have clashed with agriculture, for no man can fish the sea and till the land in the same season. In the Orkneys the claims of the land have prevailed. In the Shetlands the call of the sea has conquered. That fact has nothing to do with any difference of race or culture of the peoples: it is due to the great superiority of farming opportunities which the Orkneys provide. Consequently it has become a common saying in Scotland that while the Orcadian is a farmer with a fishing boat, a Shetlander is a fisherman with a croft. That definition requires some modification in modern times. Many men of Shetland have abandoned their crofts and go to sea in deep-sea craft rather than in fishing boats.

Crofting in Decline In the long strip of sea-bitten land called the mainland of Shetland, in the northernmost islands of Yell, Fetlar, and Unst, there is of course much farming land, with innumerable crofts. Already, however, many crofts have been abandoned, as many, perhaps, as there are crofts remaining in cultivation.

J. Peterson, in his beautifully illustrated book *Shetland: A Photographer's Notebook** published last year, writes: "The future of Shetland crofting is the islands' biggest problem."

That is true not only of Shetland, but of all the remote islands off the coasts of Scotland. The croft, surrounded by sentiment, sheltered by legislation, idealized by those who do not live on them, is nevertheless a dying form of agriculture. It is a survival, like the platypus. Its eventual extinction will be regretted, for in its own way it was a beautiful thing. So also was the Large Copper Butterfly of the English fenlands—but it went. The materialism of the age is swiftly killing the croft. Again to quote Peterson, "The croft has ceased to be in itself an adequate means of livelihood".

In other words, an able man—and most Shetlanders are able men—is no longer willing to remain in poetic poverty merely for the sake of being photographed. There is often more money to be made out of the photographs than out of the crofts. Those who wish to see the poetic anachronisms of Shetland life—the yoked bullock, the tethered cow, the busily knitting woman leading a lamb to grazing, cereal culture on a "pocket-handkerchief" field, ponies with peat creels on their backs—they should go there quickly

*Lindsay Drummond, 12s. 6d.

now—because the days of these fine things are numbered. The real economic difficulty of crofting, such as Shetland knew it, is that the croft fails to support a modern standard of living for a modern family. Consequently, the members of a crofting family must become wage-earners as well. The modern wage makes the profit, if any, off a croft seem trivial, consequently the croft becomes neglected. What was once a miniature farm becomes a wilderness, the croft-house a dormitory and then a ruin, while the crofter emigrates, becomes a town-dweller, or (if agriculturally ambitious) migrates to districts of Scotland where the soil is more bountiful and the climate kinder.

The agricultural future of the Shetlands would seem to lie not in crofting, but in stock. The livestock of Shetland is both valuable and peculiar. Shetlanders themselves were somewhat slow to realize the value of their stock, and the islands were at no very distant date a happy hunting ground for enterprising dealers from the mainland of Scotland. That is less true today, since, while the costs of travel have heightened, the simplicity of the Shetland crofter has decreased.

Increased Importance of Sheep The Shetlands' livestock riches lie in sheep, cattle and ponies. Contrasted with the Orkneys, no great poultry industry has been developed there. The Shetlands are not suited to produce the grain that hens require. Sheep, on the other hand, have become of progressively greater importance within recent years. Most of the deserted crofting land has been put under sheep. The islands' sheep stocks have increased from 80,613 in 1870 to 213,194 in 1948. Originally, Shetland had a sheep breed all its own, a remnant of the short-tailed, fine-woolled breed once prevalent throughout northern Scotland, the old primitive breed that Frank Osbaldistone noted on his historic ride with Bailie Nichol Jarvie to the Clachan of Aberfoyle:

> Living thing we saw none, except occasionally a few straggling sheep of a strange diversity of colours, as black, bluish, and orange. The sable hue predominated, however, in their faces and legs.

This diversity of colouring persists among the pure-bred Shetland sheep of the present day—

> Unlike the more domesticated breeds, this half-wild animal produces several shades of wool. The more common colours are white and moorit (moor-red), but there are small numbers of other natural shades such as fawns, greys and browns. (*British Pure-bred Sheep*, p. 62).

The Shetland Flock Book Society was established in 1926, in a brave effort to maintain purity in the breed. Such an effort was overdue, for the Shetland breed of sheep was rapidly being "improved" out of existence. Rams of the two main Scottish sheep breeds, Blackface and Cheviot, have been imported in numbers to the Shetlands over many years, to cross with the native Shetland ewes. An occasional Kerry Hill, Ryeland and rams of other breeds have also found their way there. The result of a somewhat indiscriminate crossing policy is that the native Shetland sheep, as a commercial animal and in its pristine purity, has almost disappeared, and that a large proportion of the islands' sheep stock is frankly mongrel. To a sheep-man some of these crosses seem more sensible than others. One of the most valuable qualities of the original Shetland sheep was the fine quality of its wool. Real Shetland wool is a beautiful article to handle. To mix this with the coarse carpet fleece of the Blackface seems somewhat of a textile desecration. The Cheviot, which itself bears a fleece of considerable textile quality, would appear to be a much more suitable cross with the Shetland. Of course, as with all attempts to "improve" primitive breeds

Shetland, looking south from Weisdale

Photo. J. Peterson.


Croft: Foula, Shetland
Photo. J. Peterson.

Crofts: Fogrigarth, Shetland

Photo, J. Peterson.

Photo: G. W. Butcher

"With lucerne, we have a plant capable of producing more protein per acre than any other plant we grow."

of livestock, there has been a curious confusion of thought. Undoubtedly a cross, say, between a pure Shetland ewe and a pure Cheviot ram, will give a valuable first-cross, a better and weightier carcass than that of the pure Shetland, a fleece of sufficiently greater weight to compensate for a certain loss of fineness in the quality. There is also the undoubted advantage of hybrid vigour in the first-cross. Yet if the practice of crossing is repeated indefinitely, there will finally be no original and primitive breed with which to cross. The reservoir, continuously drained, will soon run dry.

Again, the Shetland sheep was the basis of the Shetland textile industry. Shetland shawls and Shetland hosiery gained their reputation on the fine fleece produced by Shetland sheep and the skilful knitting of the Shetland women. Unfortunately, as in the case of so many Highland and Islands industries, production is liable to outrun resources, and reputation come to depend upon the flimsy scaffolding of legend. In plain fact there is—largely because of indiscriminate and somewhat ill-advised crossing—no longer sufficient pure Shetland wool available to support any large scale industry in native textiles. Goods manufactured from Cheviot wool on a knitting machine are not the same article as those made by handcraft from fine, soft Shetland wool. Mere geographical situation and island atmosphere perform no textile miracles.

Decline in Cattle Modern Shetland cattle, like modern Shetland sheep, tend towards infinite variety. In fact, crossing has gone further, and perhaps today the only true definition of a Shetland cow would be a cow bred in Shetland. When one thinks of the marvellous contribution made by Channel Islands cattle to the dairy industry of the world, it seems a thousand pities that island breeds, like the old Orkney and Shetland, should have suffered such a fate as to become a mere dumping ground for low-priced Scottish mainland bulls. Yet that, in fact, has been their lot. The Shorthorn was followed by the Aberdeen Angus, to be succeeded, when milk became more popular, by the Ayrshire and the Friesian.

Cattle, of any kind, are of less importance in the Shetlands than they once were. There were 29,861 cattle in the Shetlands in 1870. Today they number little more than 7,000, and were it not for the dairying round about Lerwick there would be fewer still. The decrease in cattle population is correlated with the decay in crofting. In the long, dark winter season of the Shetland Isles, cattle require the shelter and care that crofters can provide. They cannot find a living for themselves as sheep will do. When crofting land becomes derelict, sheep, not cattle, are the stock that follow. The cattle of the Shetlands are tubercle-free.

Pure Ponies Shetland ponies, as contrasted with sheep and cattle—thanks to a physical accident—have remained reasonably pure. The accident consists of the physical impossibility of natural mating between a Clydesdale stallion and a Shetland mare. Otherwise, without doubt, such stallions would have accompanied bulls and rams out of Scotland in the mistaken mission to "improve" those islands' livestock. Artificial insemination makes such mating between horse and pony feasible, but, so far, it has not penetrated to the Shetland Isles.

The original use of the Shetland pony was identical with that of all ponies in North Scotland. Where the only communications were tracks and the only fuel was peats, the pony with its creel was essential to human existence. Roads destroy the usefulness of ponies as pack-animals. More can always be carried, and more swiftly, in a cart. For crofting work far fewer ponies are now required. In fact mechanization is—as in less

remote places—fast replacing any kind of horse labour. There are, today, several hundreds of tractors at work in the Shetland Islands. Indeed the persistence in numbers of the Shetland pony is due to the islands' export trade. At one time there was a good trade for ponies to go down the mines. Since mines, like farming, grow ever more mechanized, pit ponies of any kind may soon become outdated, amid humane approval. Shetland ponies of today are in greater demand as children's mounts, not only in Britain but also in America. So long as nobody attempts to "improve" the breed, in the questionable manner in which the islands' cattle and sheep have been "improved," that demand is likely to continue.

The Shetland pony, by its pygmy size, raises the most fundamental problem in all biology—the problem which appeared to be buried with Lamarck, only to be resurrected by Lysenko. Is the small size of the Shetland pony the result of natural and artificial selection of horses of small stature—small by genetic constitution—or has the nutritional stunting of innumerable generations of the Shetland horse induced an obscure yet parallel effect upon its genes? To that question today there are two (dogmatic) answers, one on either side of the Iron Curtain.

I wish to acknowledge my indebtedness to Mr. John Jamison, B.Sc. (Agric.), Agricultural Organizer in Shetland, for being so good as to supply me with certain data relating to the islands' agriculture.

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PROGRESS IN POTATO GROWING

N. McDERMOTT

University of Nottingham, School of Agriculture

AFTER a century of variable progress, the occasion would appear opportune to review achievement in connection with potatoes, in the hope that younger agricultural advisory officers and growers generally will gain a fuller understanding and appreciation of the present-day position in the trade.

The abstraction "progress" in potato growing is defined as the contribution afforded by breeding and trial, and, furthermore, embracing those aspects concerning trade channels (growers and merchants) and the consumer. The subject-matter is thus dealt with in relation to such sequence.

Potato Breeding In the majority of cases, the private breeder has been the benefactor of the industry in providing new varieties, and few of them have received reward in keeping with the magnitude of their contributions. A hundred years ago, as a result of famine caused by the calamitous Blight attack which swept across Europe, a committee was set up, one of its primary objects being to stimulate potato-

breeding work. Since the inception of potato research in this country, thousands of varieties have been raised, but relatively few have merited the initial outlay involved in introduction.

In the matter of potato breeding, it may be stated that the public to some extent leads the breeder; for a variety to become popular it must embody those qualities preferred by the grower; namely, cropping power, freedom from second-growth, immunity or relative immunity from diseases, good keeping quality, and ease of culture. The variety must create a public demand by its colour, shape, size and eating quality, though the preference of the consumer varies amazingly within this small island.

The late Mr. Donald MacKelvie made a valuable contribution in the field of potato breeding, and his and other breeders' untiring efforts to produce immune varieties to replace those then existing, which were susceptible to Wart Disease, filled the gap made by the emergency which arose after the spread of Wart Disease in Great Britain, and the subsequent scheduling of certain areas under the Wart Disease Order of 1923.

During the past forty years, hundreds of varieties have fallen by the wayside, but, on the other hand, some valuable contributions have been made, such as Majestic and Arran Pilot, and several other well-known kinds. It is a comparatively simple matter to breed varieties immune from Wart Disease, but building up and keeping the stock in a vigorous virus-free condition before handing it over to the trade requires patience, skill, and money. Mr. MacKelvie stated that he was satisfied if he got one out of 10,000 seedlings on the market.

An important development is the scientific breeding of potatoes which is now being carried on by the Scottish Society for Research in Plant Breeding at Edinburgh, and the School of Agriculture, Cambridge. These bodies are working on different lines, and it requires new methods to build into our breeding stock blood hitherto untapped, such as the wild (but not always tuber-bearing) species of Solanums. Their programmes include the breeding of new varieties resistant to Blight and virus diseases, and maybe later on we shall have some varieties resistant to frost and Scab.

Trials There were no official trial centres fifty years ago, and we read that at that time this aspect was left to the trade itself. Those who grew on an extensive scale were the quickest to take up a variety and the first to discard it for fear of being ruined. The small-scale grower was less influenced by the profit and loss because the crop formed a smaller section of his business and he took less trouble to acquaint himself with what was going on around him; and then there were those who thought they would "just grow an acre of potatoes".

The first official potato-testing centre was set up in a kitchen garden at Ormskirk in 1915, and local farmers worked in close co-operation, alarmed by the rapid spread of Wart Disease in the north-western counties. On their own initiative, they took steps to inaugurate and support tests made on existing and new varieties for immunity from Wart Disease. In 1920, the National Institute of Agricultural Botany purchased a farm in the Ormskirk district and established a sub-station there. They took over the potato trial work, together with the staff, and continued to conduct the trials on behalf of the Ministry of Agriculture, on land heavily infected with Wart Disease.

In 1900, Wart Disease was referred to as a new disease of the potato, and the discovery of immune varieties first brought to light by Mr. Gough in 1908, provided a basis for new varietal selection. Facilities were provided at

Ormskirk for such a basis, thus giving a stimulus to breeders in their efforts to fill the gap in the choice of suitable kinds, which the official exclusion of susceptible varieties had occasioned; it also provided an opportunity for recording accurate descriptions of the botanical characters of the varieties examined. Thus started the reorganization of the potato industry.

In 1922, Miss M. Glynne of Rothamsted Experimental Station developed a method of laboratory testing for Wart Disease, and methods were elaborated at Ormskirk in order to carry out rapid susceptibility tests for the convenience of breeders, who now could receive reports in a few weeks instead of one or two years. The successful indoor test was developed and improved so that it could be used with confidence, and this was the main factor in inducing the Ministry to close the station there. In 1940, the Ministry decided to transfer the laboratory tests for Wart Disease to its Plant Pathology Laboratory at Harpenden, and at the same time establish field plots in the Wart-free area at the Midland Agricultural College, Sutton Bonington, now the Nottingham University School of Agriculture. Here, each year, plots are provided for the training of officers of the Agricultural Advisory Service who inspect the growing crops for certification under the Potato Health Certification Scheme. In addition, there are demonstration plots showing the various grades of certified seed produced in Great Britain, plots of new seedlings under trial, a museum of old varieties, and a collection of new introductions as they appear on the market. Another section contains examples of the various symptoms induced by virus diseases. The centre is also used by the Agricultural Research Council for problems now being investigated, such as virus diseases and storage problems; yield trials are carried out for the National Institute of Agricultural Botany, whose function, under their crop improvement programme, is to put new varieties into trials at centres throughout the country.

The number of plots planted in one season in recent years at the School of Agriculture exceeded 4,000—rather formidable when compared with 17 in 1915. The value of these plots has already been proved, not only in the training of personnel, but also by the interest aroused in the large number of visitors. Surely, in this combination of interests alone, progress can be said to be very marked, compared with, say, twenty-five years ago.

Scientific Developments It is not possible to mention each scientific development in the potato industry, but a few examples are cited here. Going as far back as the middle of the eighteenth century we learn that potato plants showed "curl" symptoms, and crops from these type of plants were much reduced. A Board of Agriculture advisory leaflet published in 1913 stated:

> It seems probable that the increased vigour of potato sets from Scotland and the North of Ireland is due not only to difference in soil and latitude, but to the extra moisture available during the growing period, and to reduced sunshine during the time of ripening. That Scotland and Ireland afford a good change of seed for England has long been known, but why this should be so it is not quite clear. A number of influences are probably at work.

A Ministry of Agriculture advisory leaflet* published in 1945 (thirty-two years later) gives enlightenment in this connection:

> In most parts of England potato stocks become unprofitable after they have been grown for one or two years only. This "degeneration," or "running out" as it was often called in the past, is due to the rapid increase within the stocks of two potato virus diseases—Leaf Roll and Rugose Mosaic (Severe Mosaic).

*Advisory Leaflet No. 139, "Potato Virus Diseases." Obtainable free from the Ministry, 1 St. Andrew's Place, Regent's Park, N.W.1.

Stocks seriously affected with these diseases not only give poor yields, but may act as sources of infection for neighbouring healthy potatoes. For this reason a knowledge of the main facts about potato virus diseases should be an aid to growers, not only in the purchase of suitable seed stocks, but also in the handling of them so that losses from virus diseases are kept at a minimum.

The leaflet also contains information on the viruses causing this degeneration and advice on how to maintain healthy stocks. There was no mention of virus diseases in the 1913 leaflet, and the advice given in the 1945 leaflet may mean only a few new terms to the layman, but their significance to the whole of the potato industry is vast. The discovery that a potato variety does not die out from old age but from contamination with virus diseases has been of major importance during the past few years, when maximum production has been demanded, and thus the link between science and practice was strengthened as the necessity for increased production became more acute.

Many scientists have contributed to these findings during the past thirty years, and as a result of their efforts it has been possible to launch the Potato Health Certification Schemes throughout Great Britain. Some progress is now being made in laboratory testing for virus diseases and in the development of foundation stocks as a result of careful indexing. The occurrence and spread of virus diseases are closely correlated with the presence of certain aphides, and aphis prevalence is correlated with weather conditions. Some areas have now been "approved" as being suitable for foundation stocks to be built up and maintained from year to year. This development is due to our present knowledge of the spread of virus diseases in the field, coupled with good field or crop planning, isolation, and roguing.

No domesticated plant is more subject to parasitic or fungus diseases than the potato ; some of these still remain more or less a mystery, and the grower has to surmount them through tiresome or costly effort ; some are of little economic importance, but others may seriously or almost completely destroy the crop. The following are some of the problems now being investigated.

Dry Rot is an infection of the soil which leads to losses during winter and spring, usually after the stocks are delivered into the store. As the disease does not develop until after lifting, it depends on the conditions of storage of produce and the amount of wounding of tubers during harvesting, riddling, and transport operations. The greatest care should be exercized in handling potatoes (especially those varieties susceptible to Dry Rot) at every step on the way from the grower's field to the purchaser's store.

Potato Eelworm is the cause of the condition known as "Potato Sickness," and the attacks are now fairly widespread throughout the country. No effective method of destroying the cysts on a field scale has yet been discovered, and the only suggested control at present is as long a rotation as possible between potato crops. The presence and persistence of ground-keepers (or self-sets) remaining from a previous crop is a serious contributing factor in hindering the decrease in the cyst content of a field falling to a level considered safe for planting.

Blight was first recognized in this country in 1845 and is perhaps the most destructive disease affecting the potato ; the source of attacks still remains a mystery. Tubers may become infected if the spores of Blight are washed down into the soil. Good earthing-up is a safeguard. Other means of tuber infection occur at lifting time if the haulms have not been allowed to die down, or have not been burnt off, at least a fortnight before lifting. Blight does not spread from tuber to tuber in the clamp, but some which appear healthy at harvest-time may have a small centre of infection, and this develops rapidly if tubers are clamped in a wet state. It is essential

that storage conditions should be as cool and dry as possible in order to prevent wet rots developing.

COMMON SCAB is one of the most widespread diseases affecting the potato. The losses caused, although not so serious as in some potato diseases, are not by any means so insignificant as might at first be imagined. As a commercial article, the potatoes are rendered unsightly and their market value depreciates considerably. Further investigations into this disease are now being made.

We look forward to an early translation of the successful results of research into practical methods of control of these and many other problems.

Consumers' Preferences The consumer is as important to the industry as the grower and merchant; it is estimated that the annual consumption per person in 1947 was just under 3 cwt.—double that immediately before the war. Although diseases undoubtedly play an important role in determining the length of time during which a variety is cultivated, it should not be forgotten that popular fancy also has a strong influence. This can easily be traced to certain varieties having a direct bearing on a certain preference. For instance, fifty years ago the old Ashleaf Kidney, possessing a markedly pleasant flavour associated with new potatoes, was grown extensively, and it became so well known to the consumer that a preference for shallow-eyed kidney or oval varieties of this type followed, and the old sorts with round tubers and deep eyes were in much less favour. This is evident in the following classification of *white-skinned* varieties in general cultivation at present, and some new introductions, all of which are immune from Wart Disease.

Variety	Maturity	Shape	Eyes	First Tested in England
Arran Pilot	early	kidney	shallow	1928
Craigs Alliance	,,	oval	shallow	1947
Home Guard	,,	oval	shallow	1935
Ulster Chieftain	,,	oval	shallow	1936
Ulster Prince	,,	kidney	shallow	1946
Conference	second early	long oval	shallow	1943
Dunbar Rover	,,	oval	shallow	1933
Arran Banner	early maincrop	round	medium	1925
Arran Peak	,,	oval	shallow—medium	1933
Arran Viking	,,	oval	shallow—medium	1941
Dr. McIntosh	,,	kidney	shallow	1941
Doon Star	,,	oval	shallow	1925
Majestic	,,	kidney	shallow	(raised in Scotland in 1911)
Ulster Cromlech	,,	oval	shallow	1942
Ulster Earl	,,	kidney	shallow	1940
Ulster Leader	,,	kidney	shallow	1944
Arran Consul	late maincrop	oval	medium	1923
Dunbar Standard	,,	kidney	shallow	1934
Stormont Dawn	,,	kidney	medium	1939
Ulster Supreme	,,	oval	shallow—medium	1944

King Edward is susceptible to Wart Disease but it is very popular in England, and creates a good demand because of its regular shape and good quality, its red markings on the skin having become a feature of quality, thus setting a high standard for any new introductions of this type.

The production of parti-coloured varieties of earlier bulking capacity than King Edward is a new development in our potato culture. The following immune varieties produce tubers closely resembling King Edward, with red colour on the skin in and around the eyes.

Variety	Maturity	Shape	Eyes	First Tested in England
Ulster Premier	early	kidney	shallow	1943
Craigs Royal	second early	kidney	shallow	1943
Sutton's Olympic	,,	oval	shallow	1942
Ulster Ensign	,,	kidney	shallow	1943
Gladstone	early maincrop	oval	shallow	1930
Red Fife	,,	oval	shallow	1943

The Trade : Growers and Merchants A survey of existing varieties made in 1920 brought to light a state of affairs which has scarcely been recognized and the magnitude of which was beyond the wildest imagination, namely, Potato Synonyms. One great benefit being reaped as a result of past work is that the chaos found to exist in the trade concerning the naming of varieties is now well in hand. Potato synonyms—or, in other words, those found to be identical with existing kinds—have practically disappeared ; there were 72 per cent in 1920, and, moreover, they were often offered at enhanced prices. This was apparently not unusual fifty years ago, for it is recorded that a variety was charged £80 per ton under a new name for what under its original name could be bought freely for £5. This is how Dr. Redcliffe N. Salaman, Chairman of the English Potato Synonym Committee, summed up the position :

> Prior to the Ormskirk days, the potato had been regarded as a useful if rather dull article of food, any interest in which was, in the main, confined to the profits which might accrue in its exploitation. True, the monotony of normal trading might occasionally be broken by some financial boom, the most notorious of which occurred a few years before the Ormskirk activities began. On this occasion an inferior stock of an inferior variety was renamed Eldorado and sold for its weight in gold to a public only too ready to be beguiled. The excitement, the credulity, the folly, and the fraud, together with the final *dénouement* resembled the South Sea Bubble in miniature.

The present satisfactory state is one of goodwill existing between the trade, the departments concerned with the compiling of lists of potato varieties, and growers who are not now beguiled into paying extortionate prices for old or established varieties which have been merely renamed. Thus the abolition of potato synonyms has had a far-reaching and, we hope, permanent effect throughout the whole of the seed potato trade in Great Britain. Under present conditions, a new variety is tested in the official trials in England, Scotland, and Northern Ireland, and if it proves to be a distinct immune variety it is added to the list of approved varieties ("registered") after having been examined closely by the respective Potato Synonym Committees. It should be pointed out that distinctness of type and immunity from Wart Disease, though important, do not comprise the hallmark of perfection in a potato variety.

Some of the factors vital to any chance of successful cropping are wholly or partly in the hands of the grower, and neglect of any particular one may result in greatly reduced yields, and even serious crop failure. A few such features are : use of healthy seed, treatment of cut sets, size of seed and time of planting, and of course, manuring and cultivations, all of which are subjects for separate discussion.

In an attempt to regulate the potato industry in Great Britain, a Potato Marketing Scheme came into force in March, 1934, after having passed both Houses of Parliament ; it was administered by a Board consisting of some thirty growers, elected by vote and representing all the potato-growing districts. The scheme was drawn up by potato producers themselves, its main objects being to prevent over-production in Great Britain and to limit imports from foreign countries. In brief, all growers of more than one acre had to register with the Potato Marketing Board and could dispose of their produce only through merchants duly authorized by the Board. The maximum acreage of potatoes allowed each grower was known as his basic acreage, and was that grown by him in 1933, or the average for the three preceding years. For each acre grown he had to pay the Board a levy of 5s., and if he wished to increase his basic acreage he had to pay a levy of £5 for each additional acre. The scheme was not a trading one ; in times of glut the Board imposed the use of certain riddles, but it had no powers to fix prices. Seed potatoes were not affected by the scheme.

At first it bristled with difficulties, the main one being that the Board had to deal with some 75,000 growers, approximately 60 per cent of whom grew less than 5 acres each. To organize and influence thousands of independent and conservative growers was an arduous task, but the Board had the necessary powers to inflict penalties in cases where its regulations were not carried out. The mere fact that the scheme was the growers' own conception and entirely financed by them had a steadying effect on the individual farmer. The Potato Marketing Board was absorbed into the Ministry of Food during the war.

Potato merchants are as fully alive to potato problems as are the growers themselves ; their interests in the crop are now wider than a mere business transaction. In 1945 a training course which has since become an annual summer course for representatives of seed potato firms was inaugurated at Sutton Bonington. They are thus able to keep abreast of the latest developments in agricultural research as affecting the crop, such as breeding work and storage problems, pests and diseases ; and the trade is also kept up-to-date on the new varieties as they appear in commerce. There is no keener section of the potato industry than English seed potato merchants, and the opportunities now afforded by such organization should have a marked improvement on the industry as a whole.

The Search for Disease-resistant Varieties

In 1851 a New York minister made plans for breeding potatoes with the idea of developing more vigorous varieties that would be able very largely to resist disease. Among those he produced from South American kinds was one introduced under the name of Garnet Chili ; from a naturally fertilized seed ball taken from that variety Early Rose was produced, and from that variety came many well-known kinds. Magnum Bonum and the old maincrop Langworthy are stated to be derived from a berry taken from Early Rose. We are directly and indirectly indebted to Garnet Chili for a large number of our varieties, including Abundance, Early Market, Epicure and Golden Wonder, the latter being a russet-skinned selection from Langworthy.

None of the varieties tabulated here is absolutely Blight-resistant, though some show varying degrees of resistance. The *wild* South American varieties are now being used in our breeding work ; they have been classified and are available to breeders from the Commonwealth Potato Collection

at Cambridge. Some have proved to be immune from Blight, although their tubers are unsuitable for our type of culture. Success has followed the incorporation of such material in association with domestic kinds, in so far as immunity from Blight is concerned, simultaneously concentrating on commercial qualities. The potato-breeding programme now being carried out on these lines by the Scottish Society for Research in Plant Breeding shows that the Blight fungus has already developed three biotypes now recognized as "A," "B," and "C". "A" strain forms the Blight population under commercial conditions. So far no variety resistant to all three biotypes is available commercially, but two varieties resistant to "A" and "C" strains have recently been raised and named by the Society; these are Craigs Bounty and Craigs Snow-white, both maincrops with white kidney tubers.

We have gone a long way in the past few years—from the days of the old "C.L." (Clean Land Certificate), which had no bearing on the health of the crop and was merely a certificate indicating that the seed had been grown on land free from Wart Disease. The issue of this certificate was suspended when the 1941 Wart Disease Order came into force.

Acreages and Yields In 1900 the potato as a farm crop in Great Britain exceeded just over half a million acres yearly, and it appears to have been stabilized at that figure up to the immediate pre-war years. In 1948 the total acreage in the United Kingdom was slightly over 1½ millions, about 1 million acres being in England and Wales. Furthermore, there has been a fourfold increase in the use of Scotch seed in England and Wales compared with pre-war years.

The ten-year average tonnage per acre in Great Britain at the beginning of this century (1899-1908) was 5.85, and that for 1948 was 7.62. It would be very interesting to have the picture of the cropping trends in the maincrop group, in which there must have been a very marked increase during the past few years to compensate for the tonnage loss incurred by the lifting of an appreciable acreage of earlies at a 3–4 ton per acre level to fill the gap caused by the lack of imported earlies in the war years, and the still attractive prices ruling at the opening of the season.

The estimated crop harvested in the United Kingdom in 1948 was about 11¾ million tons, and was used in one way and another to help maintain about 50 million people in these Isles.

The acreage and tonnage have been raised, and this improvement is due to the production of heavier cropping varieties; scientific research into diseases and pest control; improved manuring and methods of cultivations; and the fact that aid of an advisory nature has been made readily available to growers. What matters most is this—is there an appreciable increase in the amount of food in good condition taken from the potato clamps? That is the marketable value of the crop. During times of stress, with greater demands on the crop, the potato has not let us down (supplies were rather low in 1947, but no blame for that could be put on the industry), and only co-operation of effort and coordination of ideas have achieved this end.

CIDER FOR FARMHOUSE AND HOME USE

Professor B. T. P. BARKER, M.A.
Emeritus Professor of Agricultural Biology, Bristol University

WITH the development of cider-making into a commercial industry during the course of the present century, and the consequent production of cider passing very largely from the farm to the factory, the number of farmers continuing to make cider from the crops of their orchards is now relatively small. Hence, many of the younger generation have little experience or detailed technical knowledge of the procedure required to produce a satisfactory beverage. That there still exists among farmers and others a desire to make cider for home use is shown by the fact that over two hundred copies of a pamphlet dealing with small-scale cider-making have been distributed by the Long Ashton Research Station to inquirers since 1947.

The present article, which is largely an abbreviated form of the pamphlet just mentioned, indicates the procedure to follow in such cases to secure a sound product. Space will not permit of any detailed description of the equipment required: in fact the circumstances and conveniences of the individual intending makers probably vary so widely that a general account would serve very little useful purpose. Moreover, advice on such matters can be obtained direct from Long Ashton Research Station.

Good Cider means Good Fruit Although correct procedure is essential if the best possible results are to be obtained, that alone will not ensure that the cider, when made, will necessarily be a palatable and well-balanced drink. That result is decided by the fruit used. This point cannot be too strongly emphasized, and much disappointment and effort will be avoided if this is borne in mind. Unless the raw material is suitable, the drinking quality of the product will inevitably be inferior. Also, it must be recognized at the outset that quality changes as the fruit ripens, and therefore the degree of inherent quality of its juice for cider-making depends on the exact moment chosen to express the juice from the fruit. Faulty methods of juice management during the making period can afterwards lower the inherent quality, but even perfect methods of management cannot add to it. Thus there are two most important distinct points involved. The first is the kind of fruit used, and the second the decision as to the best time for milling and pressing it.

Dealing first with the kind of fruit, everyone knows that individual varieties of apples differ widely in their acidity. Cooking apples such as Bramley's Seedling are extremely tart or acid to the palate, the amount of acid in the juice being frequently well over 1 per cent. dessert apples, e.g., Cox's Orange Pippin, contain only about one-half that percentage and consequently, when eaten in the fresh state, are well-balanced in flavour and not too acid, because the natural sweetness of the sugar content of the apple counteracts and balances the acid flavour. Without that sugar even a Cox would taste somewhat over-acid: so, if the juice of this variety is made into cider and all its sugar destroyed in the course of fermentation, the resulting cider will be on the tart side.

In many cases, with suitable management and control of the fermentation, it is possible to stop the fermentation of a juice before all its sugar has disappeared, as will be described later: then the drink is not unduly acid to the taste.

It is obvious, therefore, that when culinary and dessert apples only are used for cider-making the question of an unpalatable acid flavour in the

drink is likely to arise to an extent depending on the degree of acidity of the particular fruit used.

The acidity of cider apples varies widely, some varieties being as tart as Bramley's Seedling apples, and at the other extreme some containing less than one-half the amount of acid of a Cox. In their case, then, it is possible by mixing appropriate varieties in suitable proportions to get a blended juice of any desired degree of acidity

For drinking purposes a "medium-sweet" cider of well-balanced flavour should contain approximately the same amount of acid as one made entirely from dessert apples. A "dry" cider, i.e., one in which all the fruit sugar has been fermented, is apt to taste too sharp if it contains more than half that amount of acid.

Increased character and fullness in flavour are obtained if cider apples of the bittersweet class are available for blending. This is due to the fact that they contain as a rule at least two or three times as much tannin as eating apples. Their acidity is less than one-half that of a dessert apple. Where available, they should be mixed with about twice their weight of medium sharp or dessert apples to give a balanced blend.

Harvesting and Storage The apples should not be gathered until they fall freely on lightly shaking the trees. Left till then, they attain full quality. Windfalls generally yield an inferior cider. Except for the earliest varieties, a period of storage is needed to reach the best state of ripeness from the cider point of view. That can be estimated approximately by a simple test to examine the degree of softening of the flesh. Take a few specimens and firmly press them between the thumb and forefinger. When such pressure makes a definite impression on the fruit readily, it is a sign that a fit stage of ripeness for milling to give a good yield of juice has been reached.

During storage the fruit can be kept in heaps, either outdoors or under cover, but it should not be left to lie in contact with grass or bare earth because of the risk of developing an earthy taste. The heaps ought not to be of greater depth than about two feet; otherwise the fruit may "heat" and the flavour become tainted.

On no account should the apples be left longer than absolutely necessary in the sacks or other receptacles used for their collection from the orchard. The freest possible ventilation is required for the maintenance of good flavour quality.

When the fruit has reached the right stage for milling it may need some cleaning and removal of rotten specimens if the harvesting has not been done with sufficent care: otherwise a tainted flavour in the juice may result. Bruised specimens are not in themselves materially detrimental so long as the surface skin is unbroken and rotting has not started.

In such cases washing the fruit with water is recommended as a simple and reasonably efficient method. Where the quantity is not great an open tub will serve, the apples being tipped into the water and stirred with a wooden stirrer for a few moments. Adherent dirt, grass and leaves are thereby washed away, while the rotten apples sink to the bottom of the tub. The sound apples float and can be collected readily for transfer to the mill.

Processing MILLING AND PRESSING. The methods of expressing the juice from the fruit by the combined processes of milling and pressing are outside the scope of this article; but, since for relatively small-scale operations the equipment used in individual cases will probably

vary appreciably in efficiency as regards yield of juice, a procedure for improving the yield of juice is worthy of mention.

After the milled apple pulp—or "pomace," as it is technically termed —has been pressed, the residue of the fruit tissue still contains considerable unexpressed juice. A fair proportion of this can be obtained by a second pressing. Before this is done, the residual pomace from the first pressing should be broken up as finely as possible and moistened by the addition of a small quantity of clean water. This aids the subsequent extraction of the juice by the second pressing, and a somewhat larger yield of a slightly diluted juice is thereby obtained.

FERMENTATION. *Preliminary Stage.* The expressed juice should be strained and put into thoroughly cleaned casks without delay, each cask being filled to the bunghole and kept in a cool place where the temperature is fairly steady. The use of clean casks is particularly important; many ciders which otherwise would have been good have been completely spoilt by flavour taints acquired from dirty casks.

Fusty casks should be ruled out absolutely. The others can be cleansed effectively by steaming—if a supply is available—after previous rinsing out with clean water. Failing steam, an alternative is a hot solution of washing soda in water (2 lb. in 10 gallons) or one of the various commercial detergents with antiseptic properties; this is left standing in the casks overnight. Thorough rinsing with cold water several times is then necessary to remove all traces of the solution.

Within a few days active fermentation starts spontaneously, the first signs being the discharge of a whitish froth through the open bunghole. This discharge may continue for several days, the froth carrying with it fragments of fruit tissue, which were in suspension in the juice. This frothy "head" should be removed periodically and the outside of the cask kept clean. After the discharge of the froth ceases—usually in about a week—the bunghole must be closed in such a way that the carbon dioxide given off during the later stages of the active fermentation period can escape, while the inlet of air is prevented. The simplest method is to insert a well-fitting bung loosely in the bunghole. The drawback to this method is that there is no outward and visible sign to indicate the progress of fermentation—whether it is still active, or slowing down, or at an end.

For that reason the use of some form of fermentation trap or air lock is an advantage. Of these, the simplest is a bent tube of glass or tin—*on no account should lead tubing be used*—the one end being inserted in a well-fitting cork closing the bunghole and the other end dipping into a jar of water placed on the cask close to the bunghole. The frequency of the escaping gas bubbles indicates the stage reached by fermentation.

Control of Fermentation. If left to itself the juice will usually continue to ferment until all the sugar has been converted into alcohol and carbon dioxide. The resulting cider is consequently "dry," i.e., lacking in sweetness. Whether a "dry" or a "sweet" cider is desired ultimately, it is an advantage to prevent too rapid or extreme fermentation. For this purpose, "racking" is helpful.

The process of racking consists essentially of a separation of the liquor from the layer of deposited yeast and other solid material which gradually settles down from the fermenting juice on to the bottom of the cask. This is done by carefully syphoning or pumping off the liquor into a clean cask. A rubber tube can be used for syphoning, or a small hand-pump for larger quantities. Care should be taken to avoid any preventable disturbance of

deposits in the cask and to carry out the complete operation with a minimum of exposure to air.

It is difficult to give precise instructions regarding the correct time to rack, as some juices normally ferment to dryness in fourteen days or less, whereas others retain a considerable proportion of their natural sugar over a period of two or three months, or even more. The nearest general guide as to racking time is when the fermenting liquor begins to show definite signs of clearing. Quick fermentations are usually a feature of the juices of cooking and dessert apples: these should be racked immediately after the solids cease to pass through the bunghole and again, after intervals, as may be necessary to hold the fermentation in check.

The juices of many cider apples of good vintage quality ferment at a slower rate, and clarification of the liquor tends to appear while some sweetness still remains. If racking is done then, the cider will generally hold its sweetness for some time. Should signs of renewed fermentation appear after an interval, a further racking may help to retain sweetness for a further period. Such naturally sweet ciders, if they have cleared reasonably well as the result of racking, are fit for drinking forthwith, although a period of storage for maturity normally improves the quality.

Dry Cider. The cider should be racked from its deposit before the actual end of fermentation, in order that the racked liquor may continue a slight fermentation and evolution of gas. This tends to prevent the development of acetic (vinegar) taint during the clarification stage.

When fermentation has stopped, the liquor is left undisturbed until it has cleared satisfactorily. Then it should be racked into its ultimate storage cask, this being filled to the bunghole and bunged down securely without delay.

Sweet Cider. Most people, other than seasoned cider-drinkers, prefer a "sweet" to a "dry" cider. It has been mentioned already that sweet ciders are sometimes obtained without special treatment owing to fermentation coming to a natural end before the whole of the fruit sugar has been converted into alcohol and carbon dioxide. Such cases are in the minority and cannot be relied upon to occur regularly.

It is possible, however, to make naturally sweet ciders from moderate or slow fermenting juices with reliability and without much difficulty if a suitable form of filter or centrifuge is available, the former being the more efficient. Both machines are too costly to justify purchase unless a substantial output of cider is contemplated or some other use for them is also served. Small separators of the type used by dairy farmers can be utilized in place of the larger type of centrifuge found in cider factories, if the bulk of cider is not large.

In either case the machine functions as a means of removing the yeast cells from the fermenting liquor, thus stopping, more or less completely, further fermentation. The treatment should be applied when the sweetness of the liquor has diminished to the desired degree. If one treatment does not stop fermentation entirely, it should be repeated about a fortnight later.

The alternative method of obtaining a sweet cider is to add sugar or saccharin, or a mixture of the two, to a dry cider. The addition should be deferred as late as possible before the cider is required for consumption, and the quantity used can best be decided by a small preliminary trial; usually about $\frac{1}{2}$ lb. of sugar to 1 gallon of cider is sufficient.

Sugar should be dissolved in water at the rate of 1 lb. per pint and boiled for 15 minutes. The syrup must be cooled before being added to the cider.

Saccharin should be dissolved in warm water and added, to taste. "500" grade saccharin possesses a sweetening power 500 times as great as ordinary sugar. The use of saccharin will not impart any appreciable degree of "body" to the cider: although the sweetness may be comparable with a cider treated with cane sugar, the fullness of flavour will be much less.

After-treatment BULK STORAGE. It is essential that all casks of cider, whether in a state of active fermentation or not, should be kept full to the bunghole. Air must be prevented from reaching the liquor: if it is not, some vinegar fermentation is certain to take place. Evaporation is taking place constantly, and an air space soon develops. Examine each cask regularly at monthly intervals and fill the air space with added cider, if available; if not, add water instead.

USE IN DRAUGHT FORM. Cider for draught use can be drawn direct from the storage cask, if this is of not more than 6 gallons' capacity and likely to be emptied within two or three weeks. If likely to be longer, it is advised that when tapping the cask one-half of the contents should be bottled in screw-stoppered bottles. These can be reserved for use after the remaining liquor in the cask has been consumed.

With casks of larger size, the cider wanted for immediate use should be transferred to a cask not larger than 6 gallons and then treated as in the previous paragraph. The rest of the contents should be racked into another storage cask of convenient size and treated as described above for bulk storage.

BOTTLING. A dry cider will not develop much, if any, sparkling condition after bottling. Sweet ciders can do so, if not bottled too late in their life: if bottled too early, excess gas pressure may result, with a consequent serious risk of bursting. The approximate right time for bottling can be found by the following test. Fill two bottles three-quarters full: cork and keep in a warm place (65°-75°F.) for a fortnight. If then only a small deposit has formed and the cider is sparkling when poured out, the main bottling can be done forthwith. Should the deposit be heavy and the liquor over-charged with gas, bottling should be deferred and similar tests made at monthly intervals until the result indicated in the previous sentence is reached.

The bottles used should be capable of withstanding a fair degree of pressure. It is a wise precaution to examine the bottled stock at intervals for the appearance of excessive deposit or signs of too much gas pressure, with a resulting danger of bursting. Should such signs appear, remove the corks to allow the excess gas to escape and then re-cork.

Metals and Cider-making Contact of the fruit or liquor with metallic surfaces is almost inevitable at some stage. Most of the common metals are attacked, with unpalatable effects upon the flavour and possible danger to health in extreme cases. Suitable metals are stainless steel, gun-metal and tinned copper (if the plating is in good condition). Bare copper should be avoided, and also zinc galvanized surfaces. Lead, as already mentioned, is highly dangerous. Iron, although not harmful, causes discoloration of the mature cider. Brass and aluminium are undesirable, but may be used if scrupulously cleaned before and after use. Good quality enamel buckets are satisfactory, as also are wooden buckets if kept clean.

FARMING AFFAIRS

More Grass from Less Land Mr. D. H. Findlay, Director of the Yorks and Lancs Province of the N.A.A.S., broadcasting recently in the North of England Home Service, drew attention to the possibilities of getting more grass from fewer acres, and so releasing more land to grow crops for human and livestock consumption.

"Obviously if we grow more arable crops for human consumption and livestock," he said, "we shall have fewer acres of grass, but we can still have more grass, by making those fewer acres more productive. Last year we had a visitor over here from New Zealand. He'd visited many countries and he was very complimentary to our farming. He did however make some reservations about our grass. He said to me: 'I've noticed that you people here seem to have a great veneration for ancient monuments—at least I cannot think of any other reason why you don't put the plough into some of these old hidebound, benty pastures of yours.'

"Now I think he's quite right: I'm not going into details but there are just one or two suggestions I want to make.

"Firstly I believe that much of our good grass can be made even more productive by being fairly generous with lime and fertilizers. I was over in Holland not long ago, and I must say I was tremendously impressed by the output of grass they were getting on some farms there—and they do use a lot of fertilizers. That I think is one thing we might think about.

"My second point about grassland improvement refers to the poorer grass. Here I believe in the plough—turn the old stuff underneath and reseed—either directly or after a few crops.

"When we get on to the really poor stuff—the marginal land—I want to suggest a little caution. I've seen quite a lot of this stuff ploughed up and reseeded and after a few years go back to a condition very little better than it was to begin with. If land is really poor you can't expect it to grow a first-class sward straight away, and the first thing to do is to raise the fertility of the land. There are different ways of doing that—as good a way as any is to grow one or even two pioneer crops—rape or rape and soft turnips, or a cheap mixture with rape and Italian ryegrass. Eat these crops off on the land with sheep and then you'll have a much better chance of getting a decent sward to grow."

Research Institutes for Engineering, Grassland and Vegetables Three agricultural research institutes have been established as from October 1 by the Ministry of Agriculture acting in co-operation with the Department of Agriculture for Scotland and the Agricultural Research Council. They are under independent governing bodies constituted as companies limited by guarantee and without share capital. Particulars of the institutes are as follows:

National Institute of Agricultural Engineering. This Institute has its headquarters at Silsoe, Bedfordshire, and was formerly under the direct control of the Ministry of Agriculture, with a Scottish sub-station at Howden, Midlothian, which was under the direct control of the Department of Agriculture for Scotland. The staff and work of this Institute have been transferred from the Ministry of Agriculture and the Department of Agriculture for Scotland to the new independent governing body under the chairmanship of the Rt. Hon. the Earl of Radnor. Mr. W. H. Cashmore continues to be the Director of the Institute.

Grassland Research Institute. The headquarters of the Grassland Research Institute will, for the time being, be at Drayton, Stratford-on-Avon. The new governing body has taken over from the direct control of the Ministry of Agriculture the work and staff of the Grassland Improvement Station at Drayton, together with the responsibility for developing a new site at Hurley, Berks, to serve as the new headquarters of the Institute. The Chairman of the governing body is Professor H. G. Sanders of Reading University, and the Director of the Institute is Dr. William Davies, who was formerly Director of the Grassland Improvement Station.

Vegetable Research Station. This is a newly-established Institute, except that it has taken over from Cambridge University the work and staff of the Horticultural Research Station there. The headquarters of the Vegetable Research Station will be at Wellesbourne, Warwickshire, and it also has a sub-station at Paglesham in Essex. The Chairman of the governing body is Professor F. T. Brooks (Cambridge University), and the Director is Dr. J. Philp.

These three institutes will be financed by grant-aid from the Ministry of Agriculture and the Department of Agriculture for Scotland, and will come under the scientific oversight of the Agricultural Research Council. They will thus join the family of agricultural research institutes, comprising such well-known centres as Rothamsted Experimental Station, East Malling Research Station, and the National Institute for Research in Dairying.

Calf-rearing Subsidy If Parliamentary approval is granted, the calf-rearing subsidy will be extended to cover calves born up to September 30, 1951. Subsidy at the rates of £5 a head for steer calves and £2 for heifer calves will be paid in respect of calves born after October 1, 1949, and before October 1, 1950, which are certified to be suitable for beef production or as dairy herd replacements.

The subsidy rates payable on calves born after October 1, 1950, and before October 1, 1951, will be announced later.

Nature Month by Month—November Only the enthusiast is out and about for pleasure on these chill November days. Keeper and bailiff, woodcutter and farm-worker plod homeward with visions of fireside and good cheer to come.

In the paddock this evening there are no feeding rabbits, even on the lee side of the hedge, but maybe they will be out after dark. This morning a cock sparrow-hawk cruised swiftly down the hedge and away across the lane at the end of it. He had no luck that time; through the bare hedge the small birds saw him coming. On the farther hillside a disconsolate-looking hare lopes slowly along, picking its way through the sodden herbage.

In the crevices of our rockery and in the earth beneath it sundry toads and lizards have holed up for the winter. One of the toads, I think, is a former "pensioner" of ours. All the garden flowers that are left to us are a few dying dahlias and Michaelmas daisies, and some chrysanthemums which alone seem in full bloom and vigour. Active insect life is almost wholly absent. Our orchard nest-boxes are in demand as winter dormitories. One morning last week, at daybreak, no less than five tiny wrens came out of one of them. I remember that some years ago the wrens used a martins' old nest beneath the farmhouse eaves.

The belfry of the little, grey village church harbours a multitude of sleeping bats, and in porch and aisle are a fair number of small tortoiseshell and peacock butterflies. Up on a cross-beam there still remains the nest of a pair of swallows which, back in the summer, reared their young in

sanctuary, unperturbed by the noise and movement of human congregations. The birds, young and old, went overseas some time ago.

The river is in spate and bank high. Where, a week ago, were crystal pools and little feathery falls is now a roaring brown flood that obliterates all but the most prominent features of the river bed. Across the biggest pool there lies a dead, partly submerged pine, looking for all the world like the backbone of some prehistoric monster. More than the spate will be needed to move it.

The Moor, now, is grim and sombre ; rusty with dead ling and bracken, dripping with the cold rain that for a day and a night blew in from the sea. From a nearby tor a raven croaks a note in keeping with the scene. For the man who does not know it really well the Moor is a place to avoid for months to come ; some of the mires are deep and dangerous.

Winter is undisguisedly with us, now, with cold and fog and maybe snow ahead. The days will be short but the time will seem long before spring is here again.

F.H.L.

BOOK REVIEWS

Readers' Guide to Books on Agriculture. LIBRARY ASSOCIATION (County Libraries' Section.) 6d.

The realization of the importance of British agriculture has never been greater than it is today. This book list, which provides a useful guide among the great mass of farming literature (up to November, 1948), is therefore very welcome.

The material is arranged under eight main headings—farming background, the soil, plants, animals, farm machinery and buildings, farm products, economics and education, and there is also an alphabetical subject index, complemented by a system of cross-references to related topics.

F.C.H.

Diseases of Cereals and **Diseases of Potatoes, Sugar Beet, and Legumes.** W.A.R. DILLON WESTON. Longmans Green. 4s. each.

Very few up-to-date accounts of diseases of farm crops have been available for some years past, and these cheap and handy booklets are, therefore, sure of a warm welcome. They will be found particularly useful by both farmers and students, as the information is clear and practical. The illustrations by Ann Murray summarize the main points of the life cycle and control of each disease in an interesting way. The historical approach to the subject in the first two chapters on potato diseases is unusual in elementary books and is most instructive.

The information presented in both books is accurate as well as concise, and few slips have been noticed. Seed potatoes to qualify for an "H" certificate must now come from crops showing not more than 2 per cent severe virus, not 3 per cent as formerly. On land where the potato eelworm population is low it is stated that potatoes should be grown only once in four years ; it would have been well to have added the qualification contained in the Ministry's Advisory Leaflet 284 that once in every five years is preferable. Although the oats strain of Take-all occurs as is stated in the North of England on both wheat and oats, it is not common enough to make it necessary to avoid oats in the crop rotation.

The publication of further volumes to complete the series will eagerly be awaited.

A.B.

The Cost of Grassland on Seventy-five Farms in the West of England. V. H. Beynon and M. B. Jawetz. University of Bristol, Department of Economics.

A survey of 75 dairy farms in the West of England in 1947–48 shows that the annual cost of pasture is £3 15s. 6d. per acre, whilst the cost of hay and silage (excluding making, etc.) is £4 10s. 9d., the difference being due almost entirely to higher expenditure on manure and labour ; in each case rent is the highest single cost. The cost for establishing new leys is £6 1s. 9d. per acre for pasture and £4 18s. 1d. for hay and silage, the difference being due to higher cost of seeds for pasture. However, the acreage of new leys was only 6 acres per 100 acres of pasture and 9 acres per 100 acres of hay and silage. More stock could be carried if the acreage of new leys were increased. High labour charges for unproductive work, i.e., hedging, ditching, etc., and rent are relatively constant from year to year, and, spread over a larger number of stock, would reduce the aggregate cost of grazing per acre, which is £4 6s. 2d. on the average, ranging from under £2 to over £12.

The report brings out what the authors call a "disconcerting point," i.e., the paucity of manure applied on the farms surveyed. Twenty-nine per cent of the farmers applied no manure to pasture, and 9 per cent did not do so for hay and silage. Of the farmers using fertilizers, 69 per cent used no nitrogenous fertilizers and 67 per cent used no phosphates on pasture. The figures for hay and silage are 57 per cent and 51 per cent respectively. As the authors say : "It is imperative that the additional quantities of fertilizers made available should be applied to grassland if this country is to produce extra food to the value of £100,000,000 annually within the next few years."

R.A.R.

Profit from Fertilisers (3rd Edition). Crosby Lockwood. 15s.

The third edition of this well-known book, which contains chapters by six different authors, has appeared only three years after the issue of the second edition, whereas the second edition appeared eight years after the first. This doubtless reflects the much greater number of farmers who are now really interested in using fertilizers to their best advantage. The purpose of this book is to help such growers, and to show them how profitable is a proper use of fertilizers. The problems are a little difficult because sometimes one should use a mixed fertilizer and at other times a single straight fertilizer, but the reader will find they are discussed very clearly in this book.

Parts of this book are begining to lose their original value by being rather out of date, and this concerns particularly the chapter on the types of fertilizer available. No indication is given of what fertilizers have been available since, say, 1944, when the second edition of the book was issued, nor is it stressed that the composition of some fertilizers, as, for example, muriate of potash, depends purely on what manufacturing process it is most convenient to use. Thus though 60, 30 and 20 per cent muriates are all discussed, the possibility of the existence of the 40 per cent in use at the present time is not even hinted at.

The three main chapters that have had extensive revision are all excellent. Two are by Sir George Stapledon on the manuring of leys, pastures and hill grazing, and the only comment here is that the paragraph on the manuring of grass for drying is quite inadequate. The third is by Mr. F. Rayns on the manuring of arable crops, and again the farmer will find invaluable and sound advice on the proper use of fertilizers for each of the main farm crops. Mr. Rayns stresses in particular the great value of adequate dressings of nitrogen, for there is probably no easier way of increasing the productivity of our farms than by encouraging a more widespread use of nitrogen fertilizers.

E.W.R.

Methods of Test for Soil Classification and Compaction (British Standard. 1377). British Standards Institution. 7s. 6d.

Standard methods for the determination of the moisture content, liquid limit, plastic limit, plasticity index and liquidity index of soils, of the specific gravity and size distribution of soil particles, and for some soil-compaction tests are described with full working details. The methods are intended to be used in road-engineering work, but many of the details were worked out originally for agricultural soils, and some of the methods could advantageously be adopted as standards in agricultural work.

G. V. J.

The Right Way to Pig Keeping and Breeding. ALAN MORLEY. Right Way Books, Rolls House Publishing Co. 5s.

A concise, comprehensive and well-written textbook. Mr. Morley has given us a really up-to-date treatment of his subject, especially in the chapter on pig-keeping in times of emergency, where he displays his personal experience of the problems likely to be encountered. Another particularly pleasing section of the book is that devoted to feeding, where much sound information, relevant to both present conditions and those of more normal times, is presented. It is a pity that no word of warning is given to the newcomer in this otherwise admirable section about the difficulty in obtaining some of the feedingstuffs.

A timely reminder of pre-war conditions in the industry, including a review of the economics of the pig cycle, coupled with a warning of a possible recurrence of this state in the future, is noteworthy. In view of the present vacillating state of the industry Mr. Morley, wisely, makes no attempt to estimate returns from a pig-keeping enterprise, although he is optimistic about the future and concludes his book with some very sound hints to those about to start such a venture.

Informative and interesting chapters on other aspects of pig husbandry are included, together with a few well-chosen notes on backyard pig-keeping.

R. B. W.

Pigs. J. W. REID. Farmer and Stock-Breeder. (Spon Agricultural Series). **16s.**

This book has been compiled from lectures given to students by the author, over a period of twenty years. These have been brought up to date, and this information, together with Mr. Reid's practical experience gained whilst supervising the herd of pigs at the Hertfordshire Institute of Agriculture, makes the book most acceptable to anyone with an interest in pigs or pig-keeping.

The student searching for knowledge, or the practical pig-keeper, will find the book of immense help. It combines the theoretical and the practical sides of pig husbandry in a most satisfactory way. It covers all the aspects of pigs and pig-keeping. The chapters dealing with the pig industry will be of most help to the student whilst those on economics and pig housing make worthwhile reading for anyone starting pig-keeping at the present time. Herdsmen will find much to interest them in Mr. Reid's writings on feeding and management, and they should benefit considerably from the many very practical tips given, some of which may be well known but all of them well tried and of proven value.

The data collected from Pig Recording Societies and Breed Associations is a valuable asset to a book of this kind, and it helps to illustrate the value of good management.

The main breeds are dealt with, although not in great detail, and perhaps a little more discussion in the chapter dealing with the selection of breeding stock would have been welcomed by the beginner. Hygiene is discussed at sufficient length for the pig-keeper, and the book ends with a short treatise on slaughtering and processing.

W.L.

British Reptiles and Amphibia. MALCOLM SMITH. King Penguin Series. 2s. 6d.

Literature on this subject is none too plentiful, and the amateur herpetologist, especially, will be glad to have this publication. Here, for 2s. 6d., is all that he needs to know about our snakes, lizards, newts, toads and frogs. The name of the author is sufficient guarantee that the book is reliable and up to date.

One cannot refrain from hearty agreement with the author's opinion that "It is just as well" that attempts to introduce the marsh frog into parts of England, other than the Romney Marshes, have failed. Apart from the other possible unfavourable results, as the author says "A chorus of males in full song after dark has been known to keep a whole village awake," and in these days few would wish to add to the alien noises of the countryside.

The illustrations by Paxton Chadwick are almost uniformly good, although the purist might perhaps question whether the general coloration of the grass snake is truly typical. One would have liked to see, also, illustrations of a few of the colour variations of the adder.

These, however, are minor points, and author, artist and publisher alike are to be congratulated on this admirable little publication.

F.H.L.

New Plants of the Year, 1948. ROYAL HORTICULTURAL SOCIETY. 12s. 6d.

To quote the Society's modest title, this is a "Descriptive list of all plants, flowers, fruit and vegetables that have received awards from the Royal Horticultural Society after exhibition at Vincent Square or after trial at Wisley during 1948." It is, in fact, a well-bound 80-page book containing 55 illustrations, of which eleven are coloured reproductions.

The Royal Horticultural Society has eleven committees, composed of the leading experts in every branch of horticulture. One of the functions of these committees is to examine in detail the large number of new species and hybrids which are sent to the Society by commercial and amateur growers, not only in this country but from all parts of the world, and to give awards to the best. Large numbers are continually undergoing trial in the Society's gardens at Wisley.

Nearly 600 different hybrids and species are described in detail. There are seven main groups with their subdivisions as follows: trees and shrubs, of which the chief genera dealt with are camellia, magnolia, rhododendron and rosa; bulbs and corms (main genera freesia, gladiolus, hippeastrum, iris, lilium, narcissus, and tulipa); rock garden plants; orchids; herbaceous plants (mainly perennial asters, calendulas, border carnations, garden pinks, chrysanthemums (of which 90 new varieties are described), dahlias, delphiniums, lupins, primula, sweet peas, and tagetes; fruit—one apple, Laxton's Fortune, and one strawberry, Auchincruive Climax; and vegetables (mainly cauliflower, lettuce and Brussels sprouts).

Although some of the awards are described from time to time in the *Journal of the Royal Horticultural Society*, it is very desirable to have a complete and classified list in a separate publication, and this book is one which no horticulturist who wishes to keep up to date with the newest and best varieties can afford to be without.

E.S.

Root Crops. H. I. MOORE. Farmer and Stock-Breeder. (Spon Agricultural Series). 14s.

In the last twenty years the arable farmer, especially in the eastern counties, has had to discard the traditional technique of growing fodder roots and learn how to grow sugar beet and potatoes. Since the introduction of sugar beet into British farming, research on this crop has been highly organized and intensive, but the full account of the results of this work has yet to appear in book form.

The husbandry of the potato crop is, however, more fully documented, and detailed descriptions of the best practice of the specialized potato-growing districts are already in existence.

But for the farmer and student who requires a clear, general picture of the present knowledge about the old-established feeding roots and less familiar cash root crops, Professor Moore's book in the Farmer and Stock-Breeder Agricultural Series will be of great service. Besides a full practical account of the cultivation, manuring and harvesting of the different root crops, there are useful chapters on the mechanization of the root crop and seed production. A valuable feature is the inclusion of recent experimental results which not only add convincing support to the argument, but underline the trends of research and what developments may be expected in the future. Where detailed figures are quoted, however, it is suggested that the complete reference should always be given, as experimental findings detached from the " background " of the field trial may sometimes be misleading.

One or two minor comments may be made. On page 78 it is stated that 6 lb. of segmented sugar beet seed is equivalent to 15 lb. natural seed; experience, however, has shown that double this quantity is usually required. Again, reference to the pelleting of beet seed with fertilizer requires the necessary qualification that for the beet crop the drilling of fertilizer in contact with the seed usually has a marked adverse effect on germination.

P.N.H.

Farm Enterprise Mechanics. Edited by R. W. GREGORY. J. B. Lippincott Company. 18s.

This book is designed principally for those engaged in vocational teaching and for those who, having had such training, wish to extend their skill and put it to practical use. Nevertheless, for the farmer who has no workshop or only an inadequately equipped one (and how many there are !) it should be of value, especially if there is a handyman available who, whilst not a skilled carpenter or mechanic, has sufficient knowledge of tools to want to know more. It also gives constructional details of devices and equipment that can be made on the farm.

A.B.

There are full lists of tools for workshops on farms of various types and sizes, and advice on the use, care and sharpening of tools, soldering, concreting, and farm and house plumbing ; a mass of other information is also given. The repair and adjustment of farm machinery and implements is treated in an understandable manner.

Quick reference is facilitated because the book is arranged in chapters, each dealing with specific subjects, such as the farm shop, field crop equipment and repair, poultry appliances and buildings, dairy equipment and buildings, orchard equipment, garden and market garden tools, household equipment and repairs, and so on. An appendix supplies data about nails and screws, uses for old crankcase oil and inner tubes, cubic measures and the like.

A random selection of things to make and do will perhaps give a better idea of the scope of the book. Here it is : Sharpening saws, making gates, laying tiles, concrete floors for pig-sties, pig houses, hen coops, chicken feed hoppers, knots and halters, sheep loader, saddler's clamp, beekeepers' appliances, tree props, spray mixers, fruit crushers and driers, heated seedling beds, bookcase and filing cabinet, ironing board, electric wiring. A number of these individual paragraphs refer the reader to U.S.A. pamphlets, yet many give enough details to enable a practical man to set about a job in a way which has been found by experience to be satisfactory.

C.D.

I Went A'Shepherding (Third Edition). RICHARD PERRY. Lindsay Drummond. 12s. 6d.

Mr. Perry is a field naturalist of established reputation. The necessities of national service sent him a'shepherding in the West Highlands during the war years, and in this book he records his experiences there. He lived and worked as a hill shepherd in Skye, North Uist, and Argyll, and his story of hill shepherding is both vivid and accurate. At times, perhaps, he tends to exaggerate the rigours and hardships of the job. To those bred and brought up to hill shepherding, such hardships seem less remarkable. Nevertheless, these accounts of the care and management of Blackface sheep in some of the most difficult sheep-farming localities of Scotland, as seen by an educated naturalist, have a very definite agricultural value. There have, in the past, been too few first-hand accounts of the way of living of the farming and crofting communities and their animals in the remotest parts of the kingdom by those educated and trained to interpret their observations.

This book, one of several dealing with the somewhat primitive life and agriculture of the West Highlands and Islands, has had a quick success and found a wide public. That success is deserved, since Mr. Perry's book is much better than many of its kind. His style is distinguished, his matter free from false sentiment, his sense of humour delightful. Then, of course, there are the birds ! Even when working with sheep, Mr. Perry's eyes are never far from his real enthusiasm. His description of the " splendid dance of the wild swans " is the finest passage in his book—a magnificent passage in *any* book.

Rather unfortunately—one feels at his publisher's suggestion—Mr. Perry has been induced to write a postscript on "The Future of the Blackface Sheep-Farms". This would be better omitted from further editions.

A.F.

One-horse Farm. RAYMOND O'MALLEY. Muller. 12s. 6d.

Mr. O'Malley is a schoolmaster by profession. He became a farmer during the late war by direction of the Appeal Tribunal. Pacifism certainly brought some able pens to the description of farming operations. Mr. O'Malley writes well : ". . . the barn had the exaggerated calm of a chapel". He is also a skilful photographer, and some of his pictures—for example, those of hens in snow and of a horse rolling—have a noteworthy originality.

After some preliminary experience as a hired agricultural worker, Mr. O'Malley rented the farm of Achbeg (Gaelic for Little Field) in Western Ross-shire. The farm possessed 19 acres of arable ground and 193 acres of rough grazing. It carried a tied flock of 100 Cheviot sheep.

Intellectuals seem to be very fortunate in their farming adventures in the West Highlands. There is always some neighbour called Donald, or it may be Ian, who really *can* farm and who keeps things going until the intellectual retires nearer the civilization he professes to abhor and writes the inevitable book.

In some ways Mr. O'Malley's book is better than many of its kind. He writes pleasantly and sensibly of hill farming routine, of cattle, of sheep, of poultry, of hill haymaking. His facts are accurate and his observation acute, yet strangely enough, although this is supposedly a book about crofting agriculture, the most interesting chapter is a quite profound essay on Folk Art. Mr. O'Malley gets to the root of the controversial matter of the correct way to sing a Gaelic song. Realizing that conventional tone production is quite the wrong approach, he writes: "The performers are taught to aim at a rich or mellow tone, where the songs require a much thinner, more astringent quality of voice. The difference is as great as that between flute and clarinet." For such a clear analysis one may forgive many farming platitudes and peculiar political views.

A.F.

BOOKS RECEIVED

A History of English Farming. C. S. Orwin. Thomas Nelson. 8s. 6d.

Canning Practice and Control (3rd Edition, Revised and Enlarged). Osman Jones. Chapman and Hall. 36s.

Corn and Corn Growing (5th Edition, Revised). Henry A. Wallace and Earl N. Bressman. Chapman and Hall. 27s.

Severn Stream. Brian Waters. J. M. Dent. 15s.

Foot-Path Through the Farm. C. Henry Warren. Falcon Press. 7s. 6d.

How to Bottle (Revised Edition). George Fowler. Fowler, Lee and Co. 6s. 6d.

Chrysanthemums for Pleasure and Profit (4th Impression, Revised). Roy Genders. Littlebury. 7s. 6d.

Bird Migration (3rd Edition). A. Landsborough Thomson. H. F. and G. Witherby. 8s. 6d.

The Geology of Water Supply. Sir Cyril S. Fox. Technical Press. 25s.

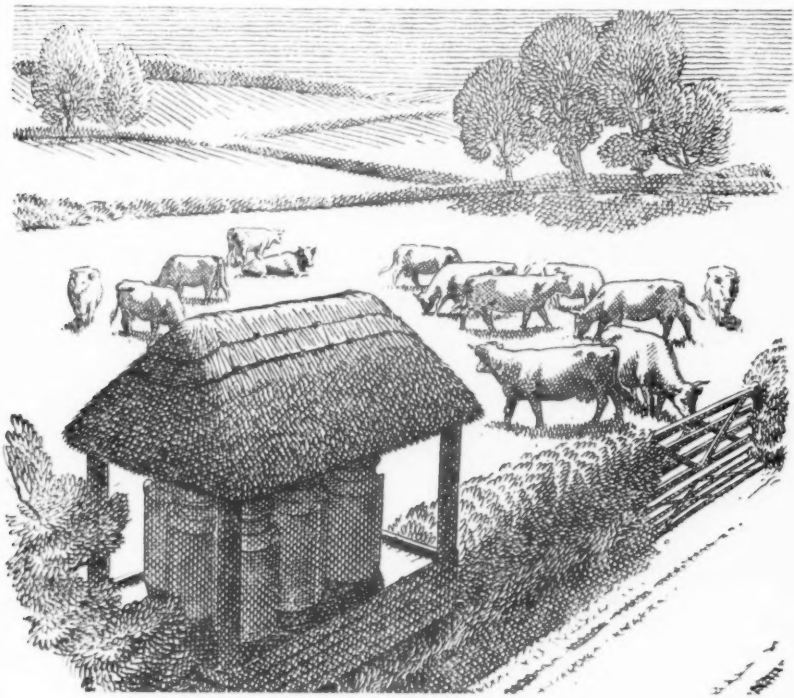
The Fruit Year Book. 1949. Royal Horticultural Society. 8s. 6d.

The Fruit-Grower Year Book, 1950. Benn Bros. 8s. 6d.

The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol (1948). University of Bristol. 12s.

Deserts on the March. Paul B. Sears. Routledge and Kegan Paul. 10s. 6d.

Printed in Great Britain under the authority of HIS MAJESTY'S STATIONERY OFFICE by C. Nicholls & Company Ltd., The Philips Park Press, Manchester, London and Reading



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